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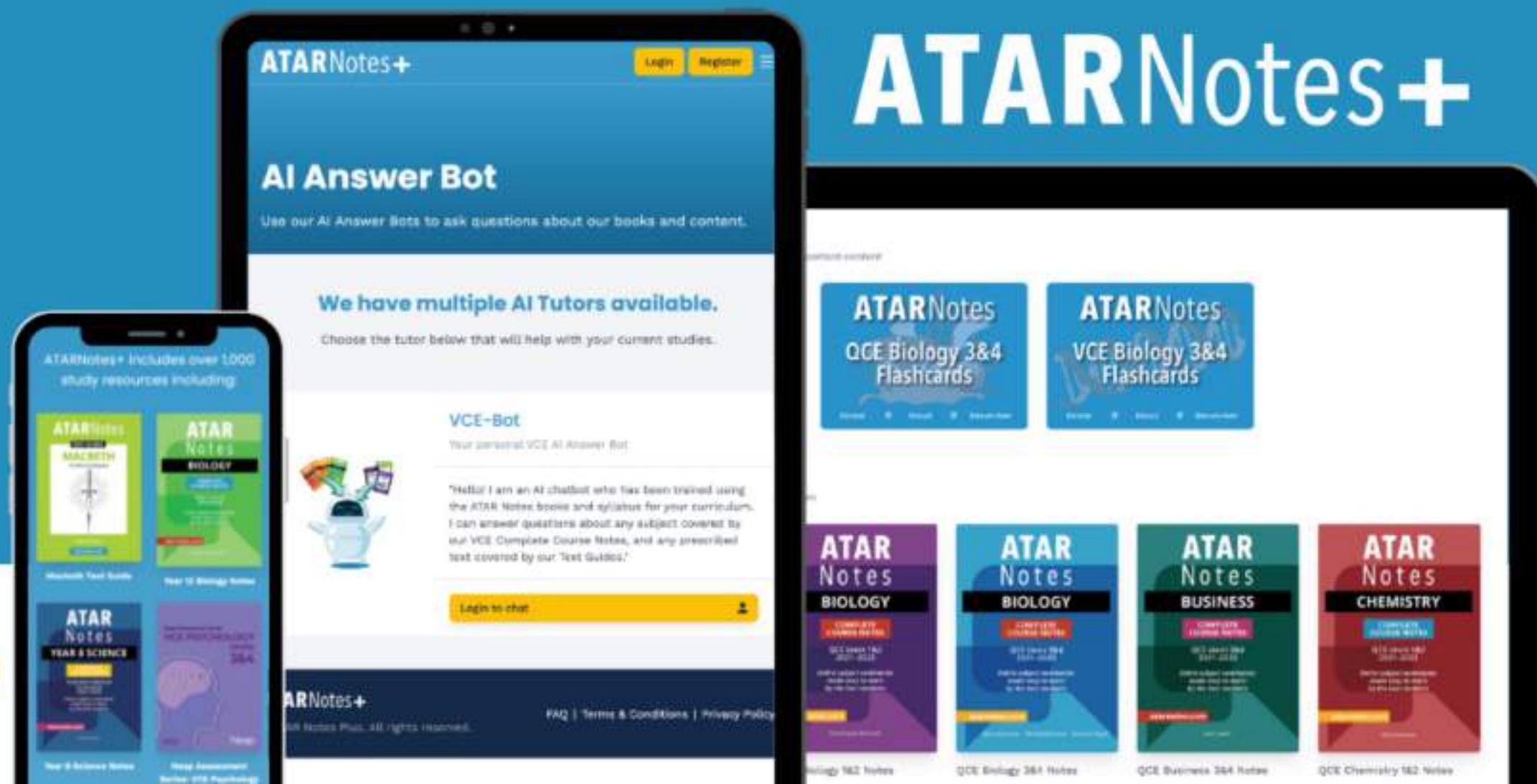
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ATARNotes

VCE Biology 1&2

ATARNotes January Lecture Series

Presented by:
Angelica

Welcome!!

Topics to be covered

- **AOS1:**

- cells
- organelles
- plasma membrane
- cell cycle

- **AOS2:**

- plant vascular systems
- animal systems
 - digestive
 - endocrine
 - excretory
- homeostasis

Ask your questions throughout the lecture; I'll be answering in the live chat ! 😊

Who am I?

- Angelica
- Writer & medical student
- Graduated high school in 2019: 49 Biology, 47 English, 40 PE, ATAR: 97.25
- 2020-2022: Bachelor of Biomedical Science, Monash
- 2023: Bachelor of Medical Science and Doctor of Medicine (MD), Monash
- Have two cats and a dog
- Ran a virtual half marathon

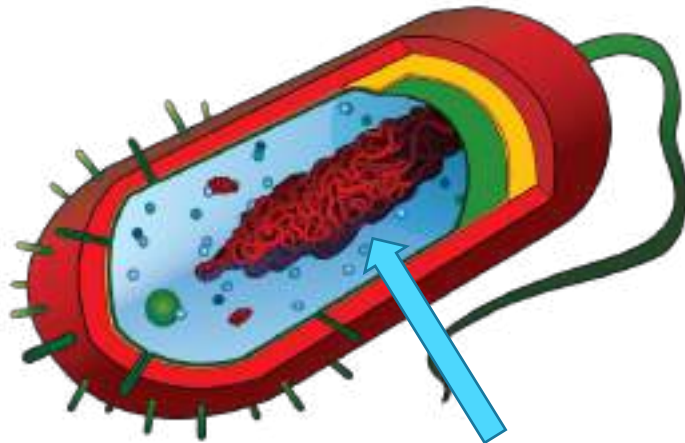


Cell Structure + Function

Prokaryotes vs Eukaryotes

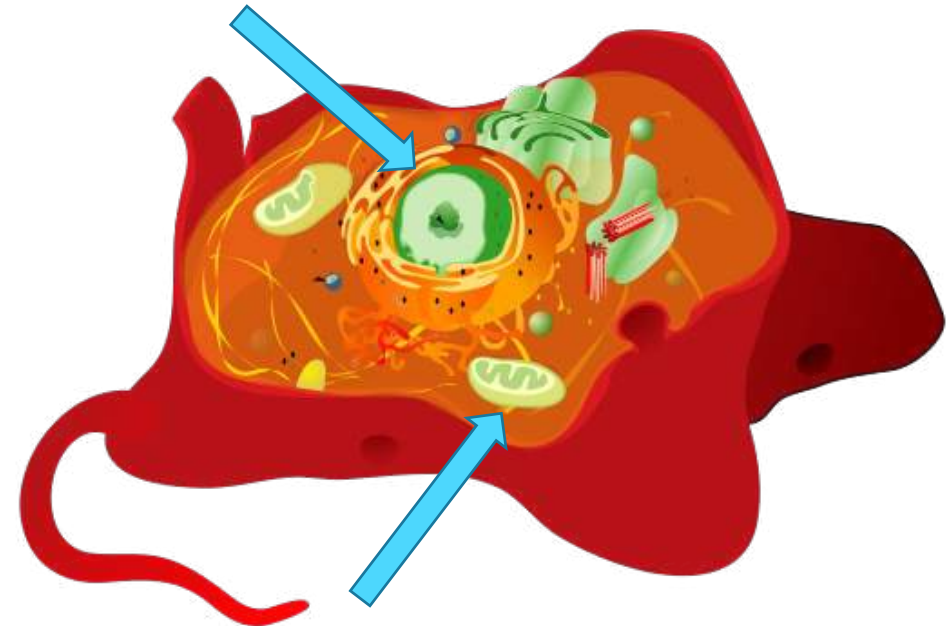
- **Prokaryotes:**

- No membrane bound nucleus
- No membrane bound organelles
- Not capable of true multicellularity
- Reproduce via binary fission



- **Eukaryotes:**

- Membrane bound nucleus
- Membrane bound organelles
- Reproduce via mitosis and meiosis

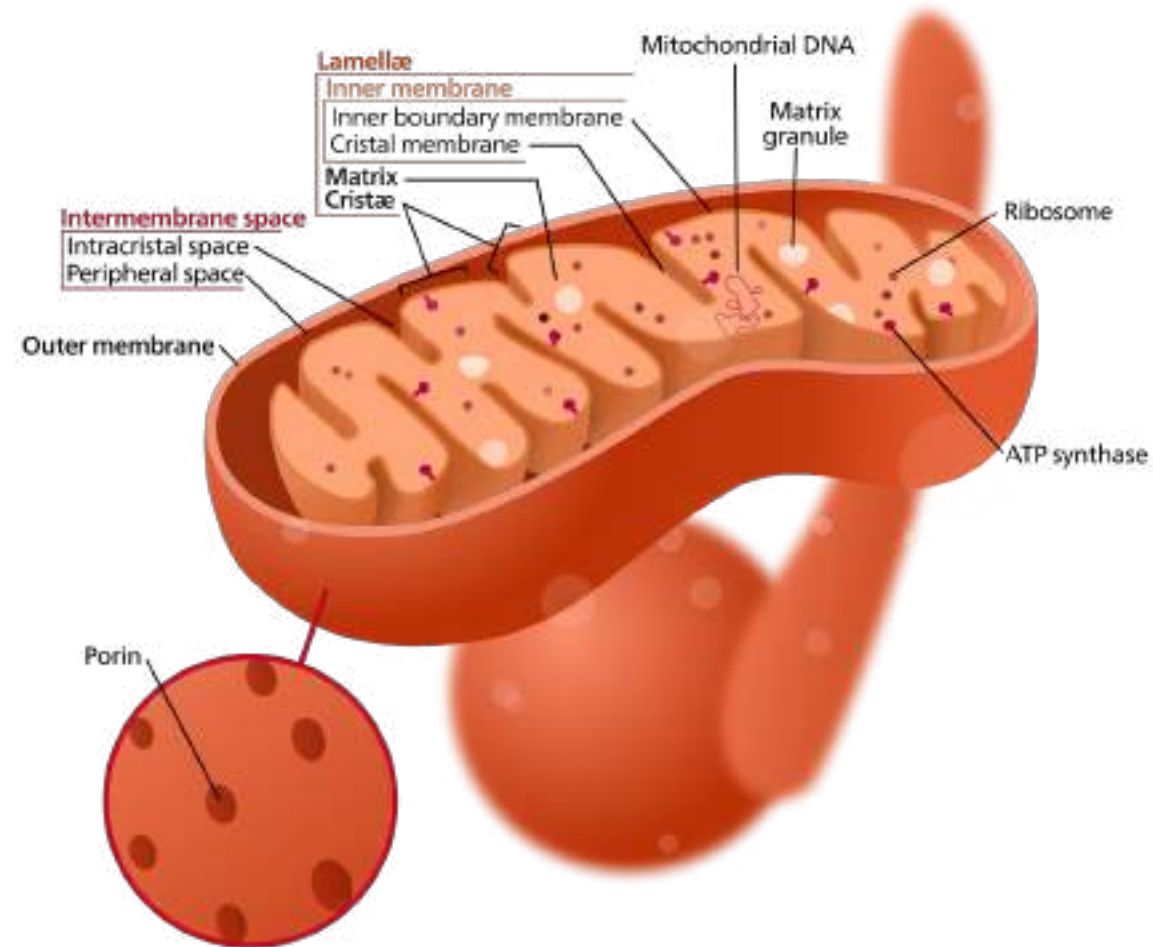


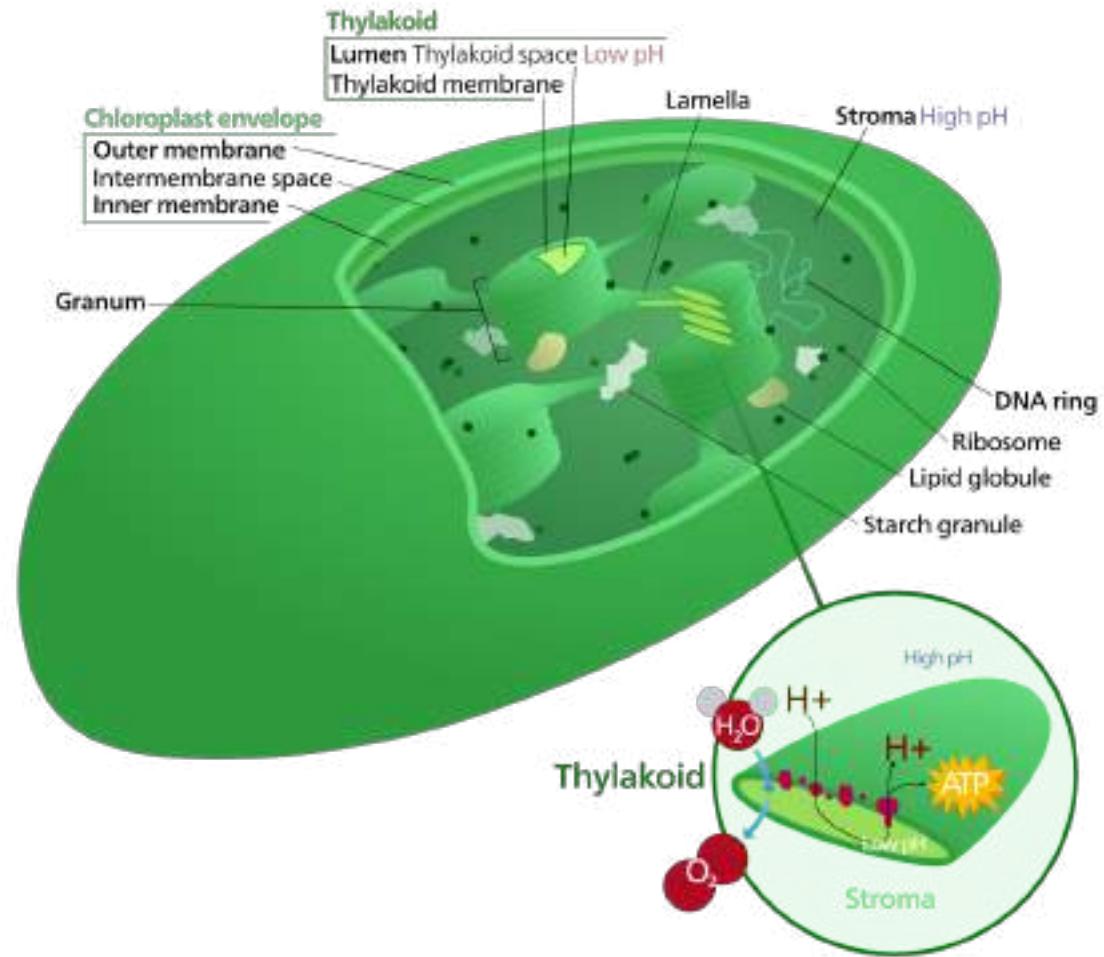


Cell Structure + Function

Organelle Summary

ORGANELLE	FUNCTION
Nucleus	Contains the genetic information of the cell as DNA -double membrane that is porous
Ribosome	Site of translation (protein synthesis) -made of rRNA-not membrane bound
Rough endoplasmic reticulum	-has ribosomes attached -transports and modifies proteins
Smooth endoplasmic reticulum	-no ribosomes -synthesis of steroid molecules
Golgi apparatus	-modifies and packages proteins into vesicles for export from the cell
Lysosomes	Vesicles containing enzymes that break down debris and unwanted molecules in the cell
Mitochondria	Site of ATP production/aerobic respiration
Chloroplast	Site of photosynthesis





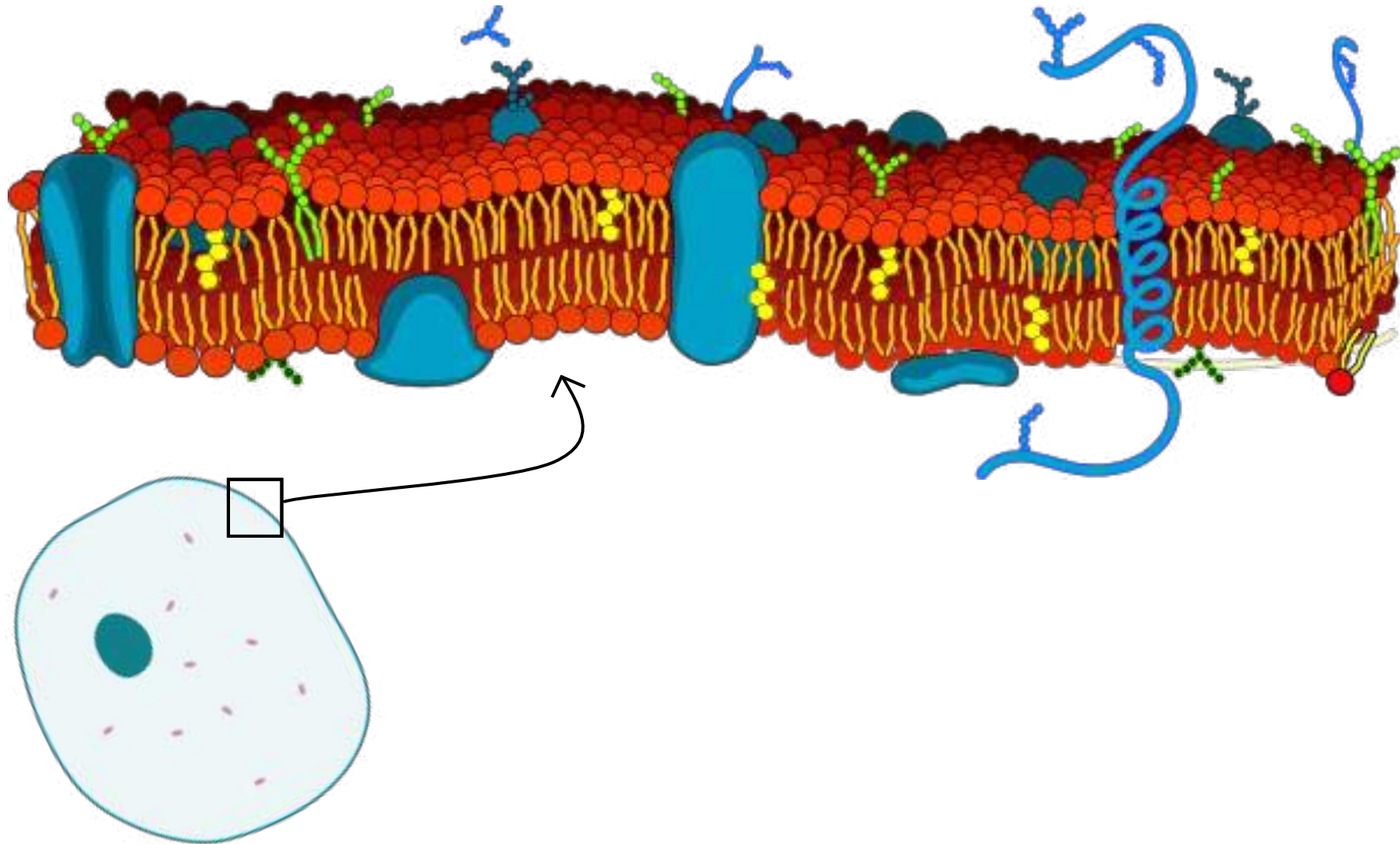
- **Hydrophilic** molecules:

- Note: the suffix '*-philic*' means 'to like', whilst the prefix '*hydro-*' refers to water
- Able to dissolve in water
- Also called **lipophobic** or **polar**
- e.g. proteins

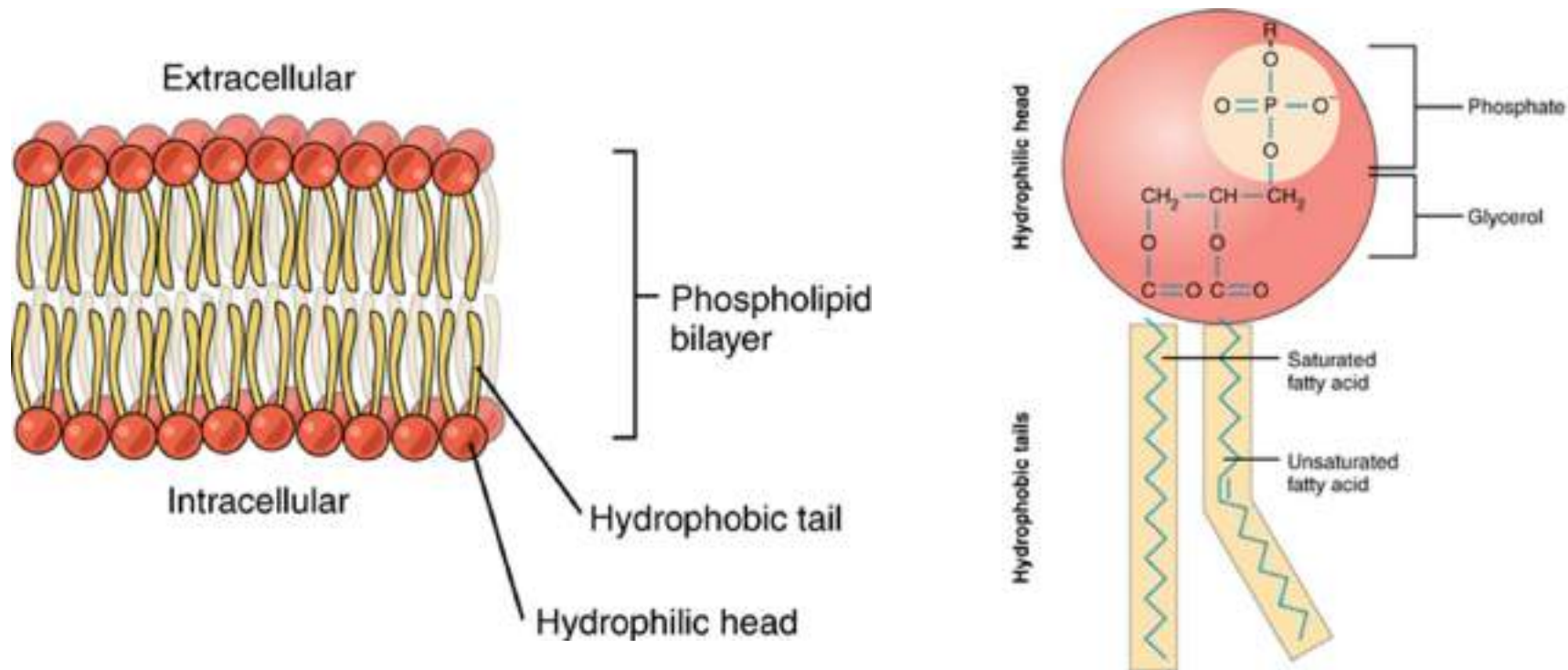
- **Hydrophobic** molecules:

- Note: the suffix '*-phobic*' means 'to dislike', whilst the prefix '*hydro-*' refers to water
- Will not dissolve in water
- Will interact with other hydrophobic molecules
- Also called **lipophilic** or **non-polar**
- e.g. oils, fats

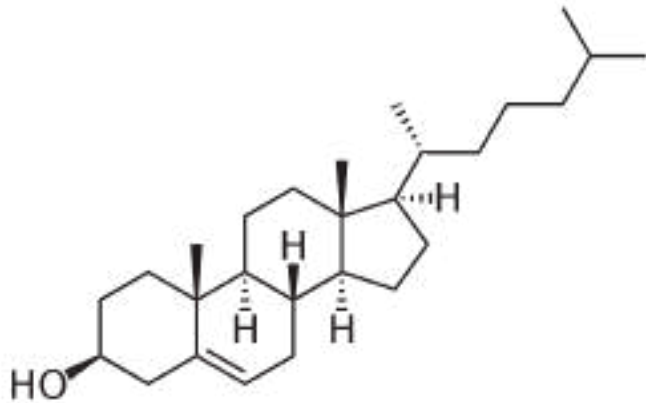




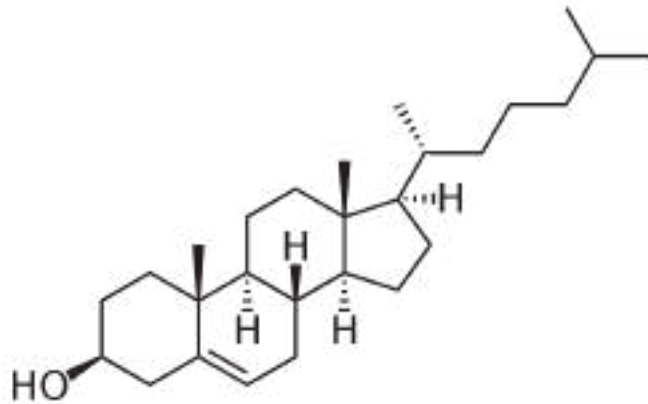
- Phospholipids are **amphipathic** – they have a hydrophilic head (phosphate + glycerol) and two hydrophobic fatty acid tails



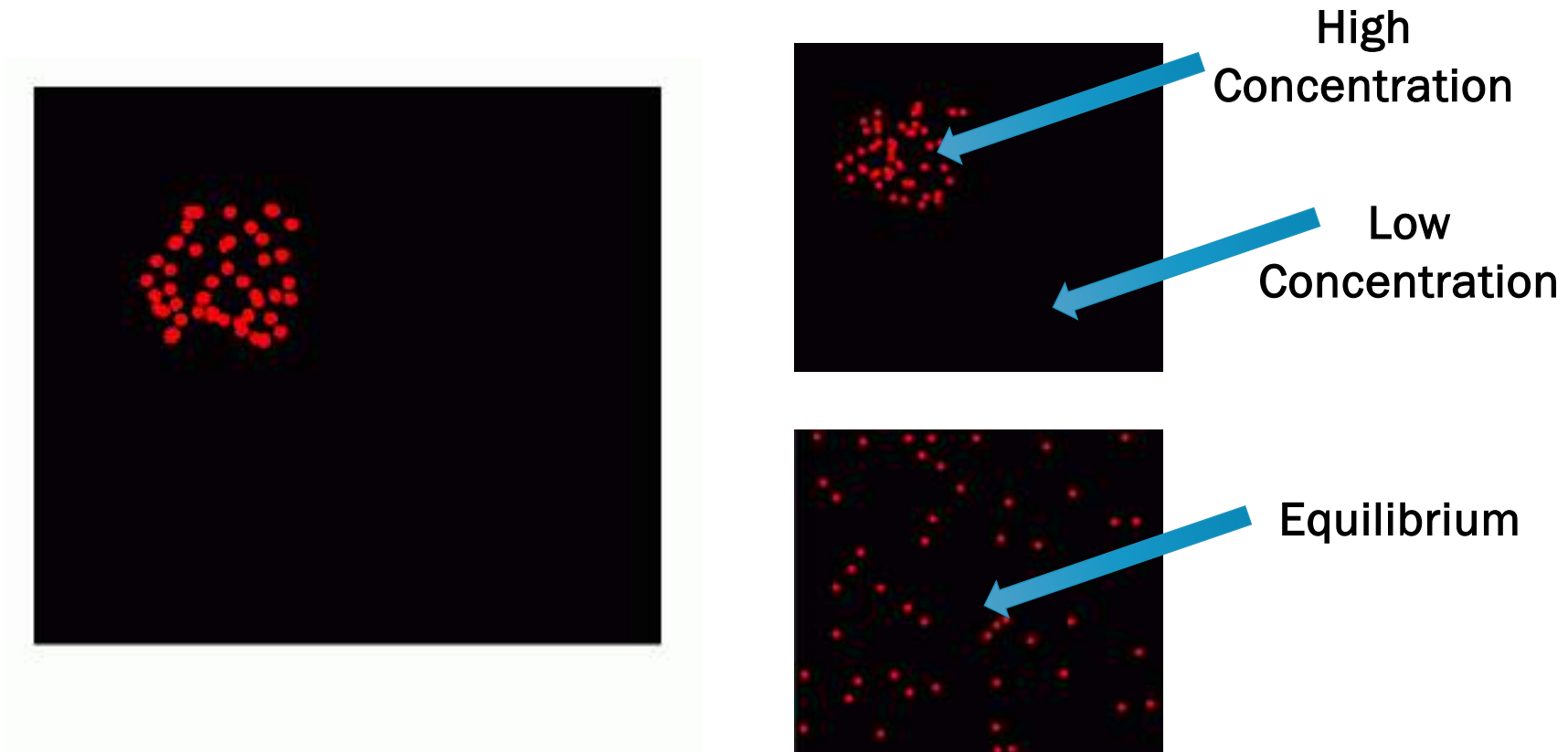
- Function 1: to prevent the phospholipids from aggregating and solidifying, thus maintaining the fluidity of the membrane



- Function 2: maintains the integrity of the membrane by **preventing the phospholipids from separating** entirely, acting as a 'glue' component

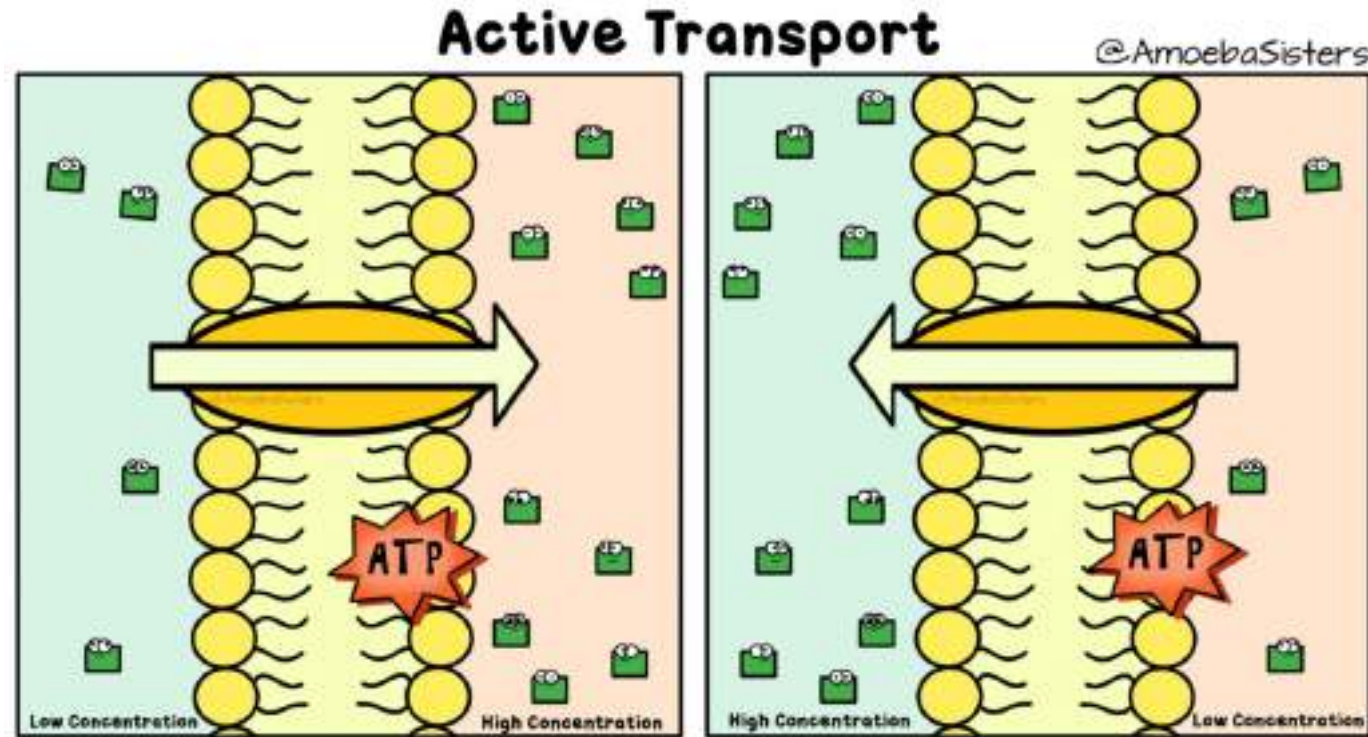


- **Diffusion:** the passive, net movement of molecules from a region of high concentration to low concentration

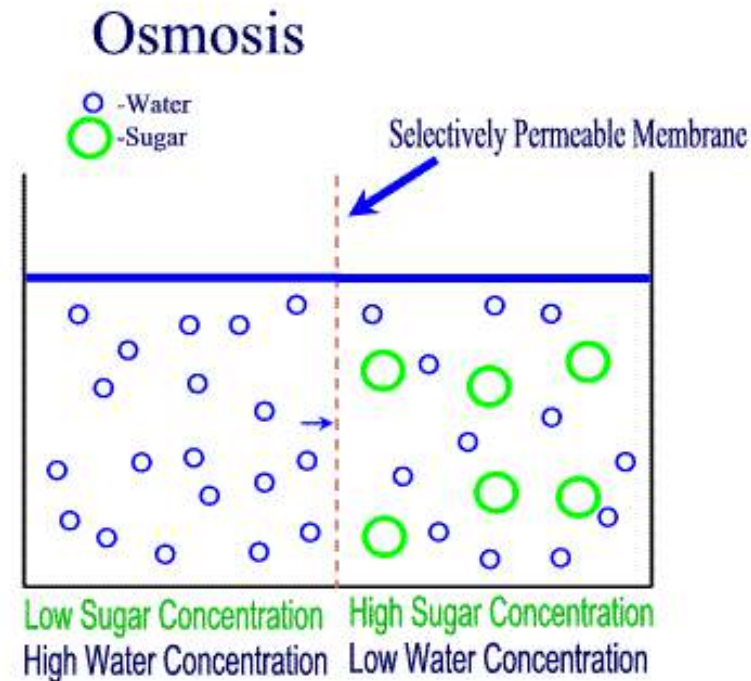


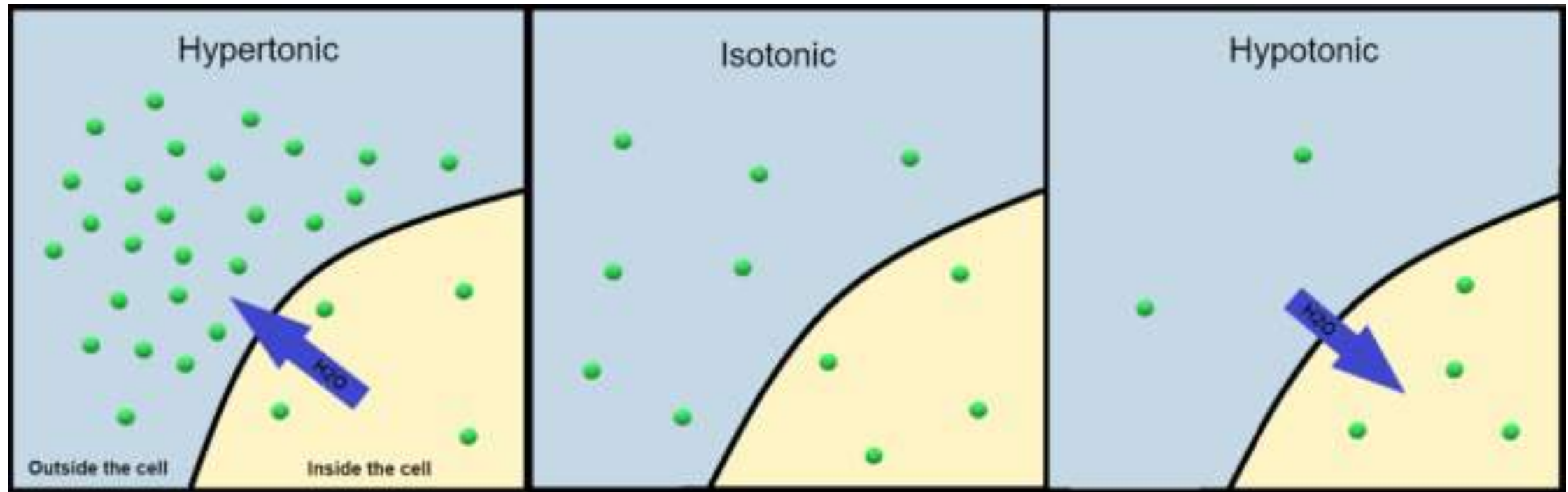
- Diffusion: the passive, net movement of molecules from a region of **high** concentration to **low** concentration
 - **Simple diffusion:** diffusion *directly through* the lipid bilayer
 - Hydrophobic substances (alcohol, steroids, etc.)
 - Very small uncharged molecules (water, oxygen, carbon dioxide, etc.)
 - **Facilitated diffusion:** the *passive, net* movement of molecules across the plasma membrane via transport proteins
 - Large hydrophilic molecules (glucose, amino acids, etc.)
 - Charged molecules (Na^+ , Ca^{2+} , etc.)

- **Active Transport:** *active movement* of molecules across the plasma membrane *against* a concentration gradient
 - Requires ATP



- **Osmosis:** the *net movement* of water molecules across a semi-permeable membrane from a region of *high water* concentration to a region of *low water* concentration



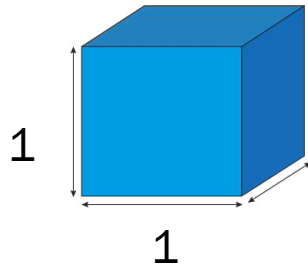


Cell Structure + Function

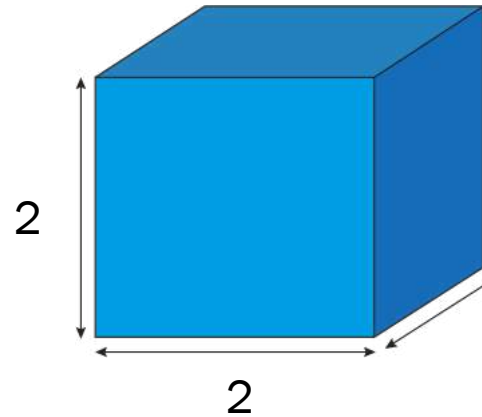
Total Surface Area = area of each side

Area of a Square = L^2

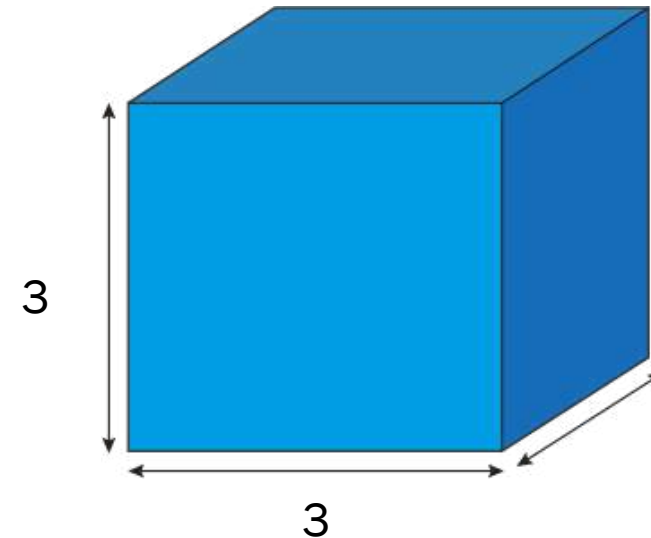
Volume of a Cube = L^3



Side Length = 1	
Total Surface Area	6
Volume	1
SA : V	6 : 1



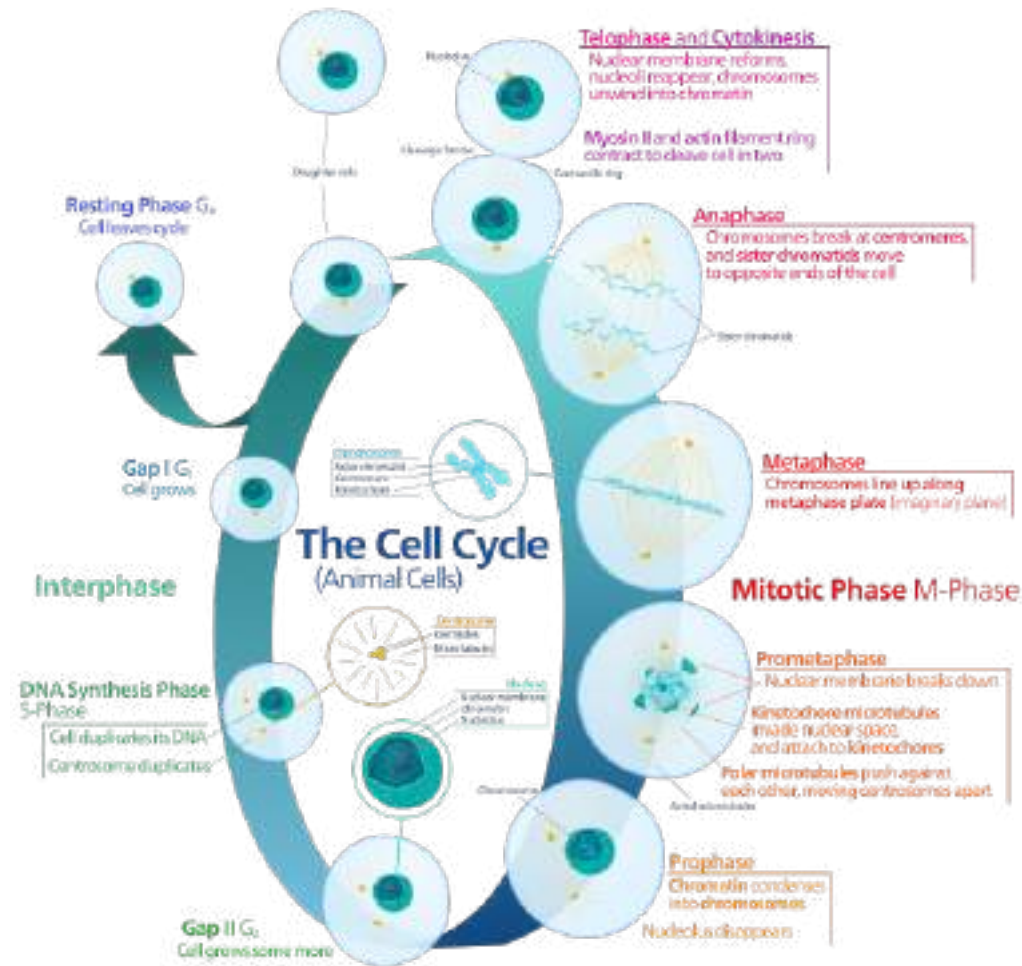
Side Length = 2	
Total Surface Area	24
Volume	8
SA : V	24 : 8 (3 : 1)



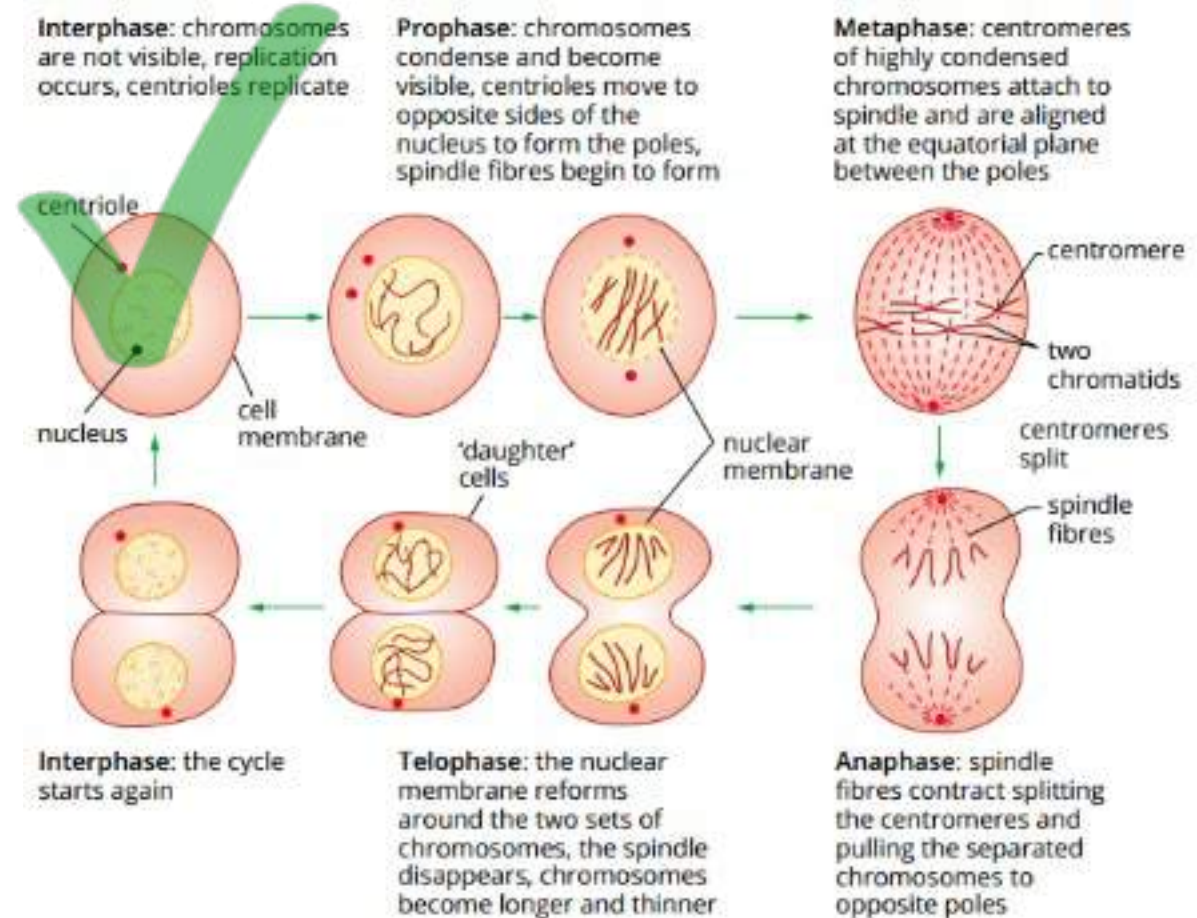
Side Length = 3	
Total Surface Area	54
Volume	27
SA : V	54 : 27 (2 : 1)

Cell Cycle

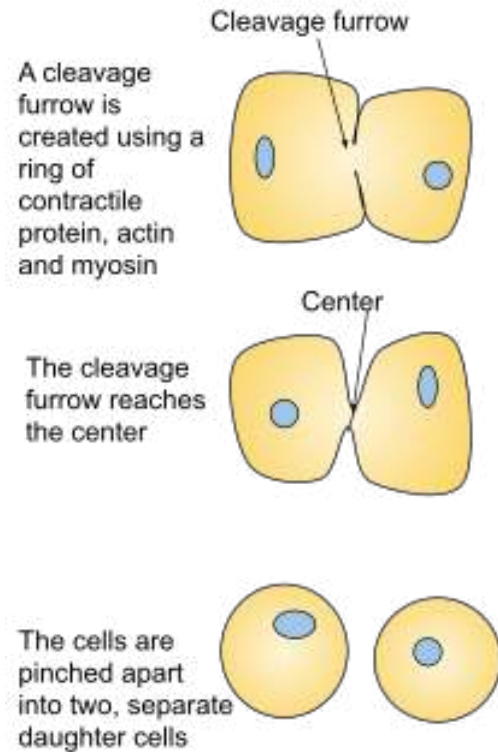
Eukaryotic Cell Cycle



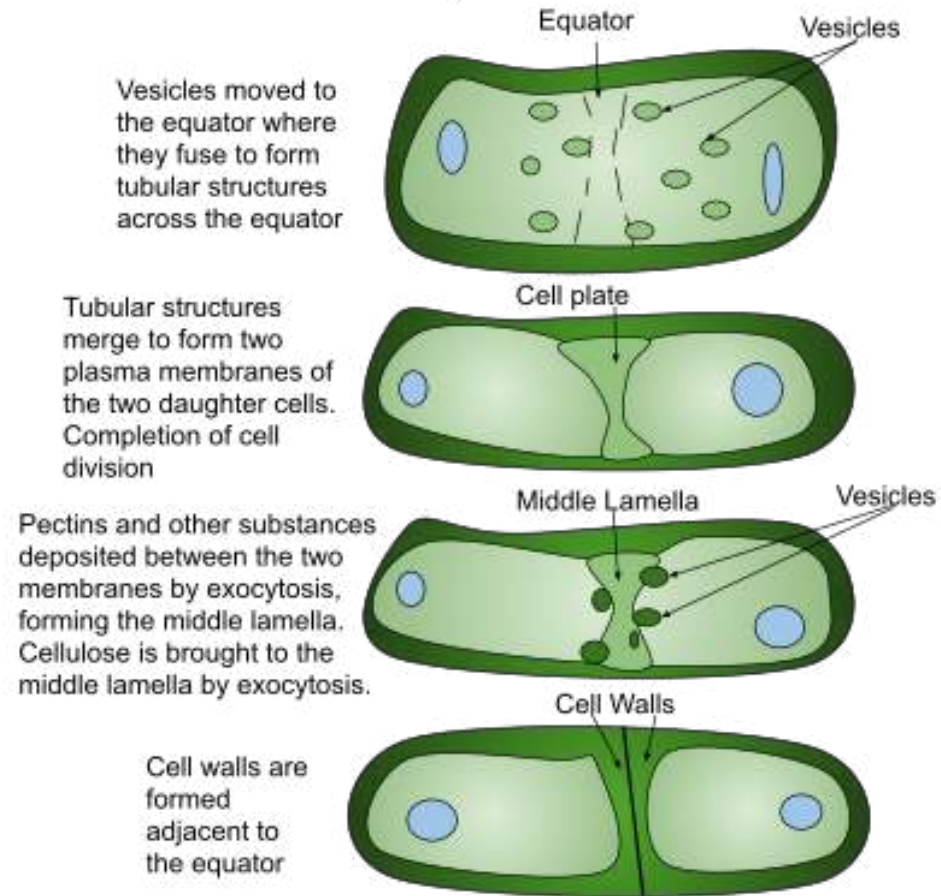
P M A T



Cytokinesis in an animal cell:

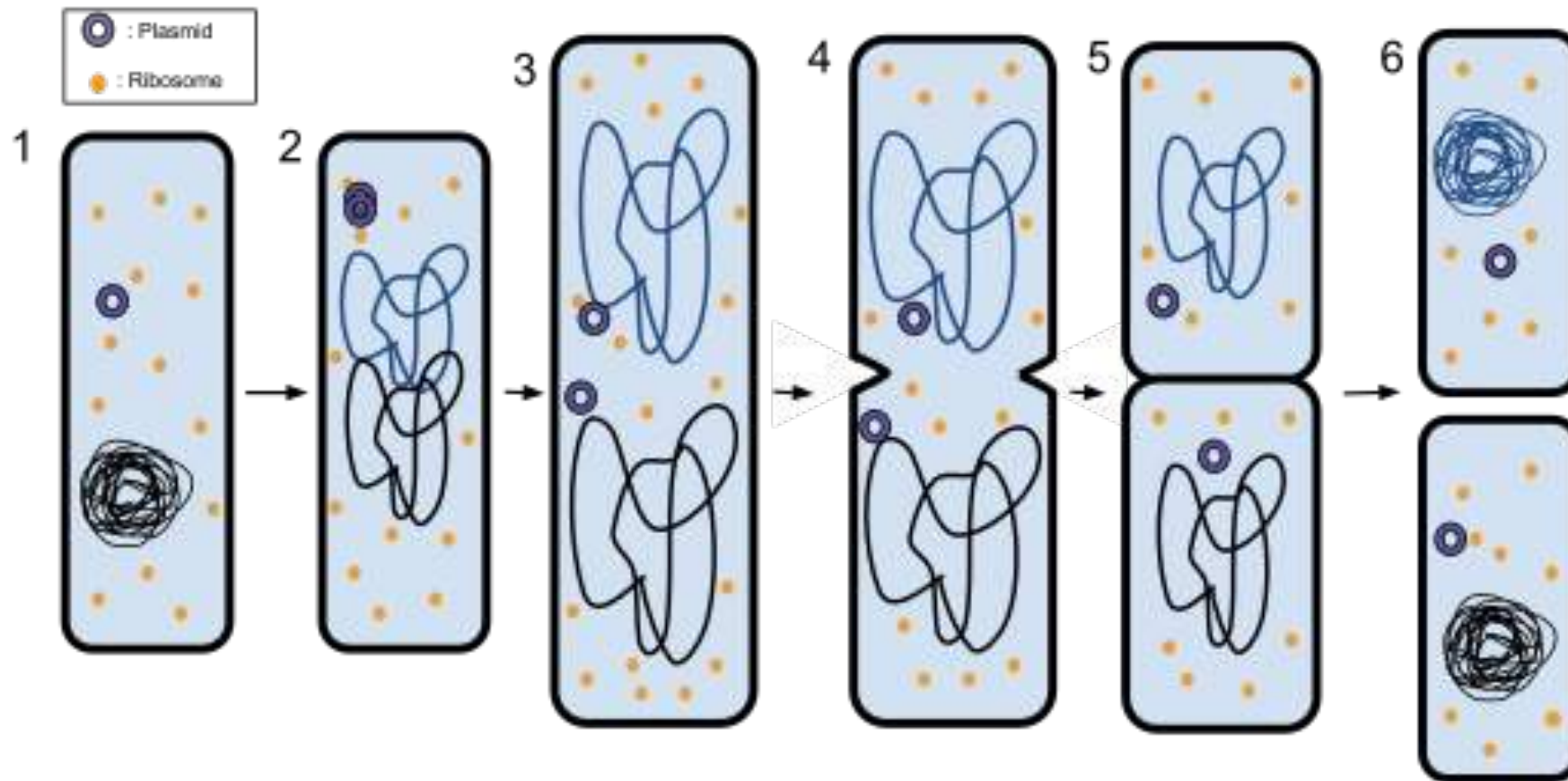


Cytokinesis in a plant cell:



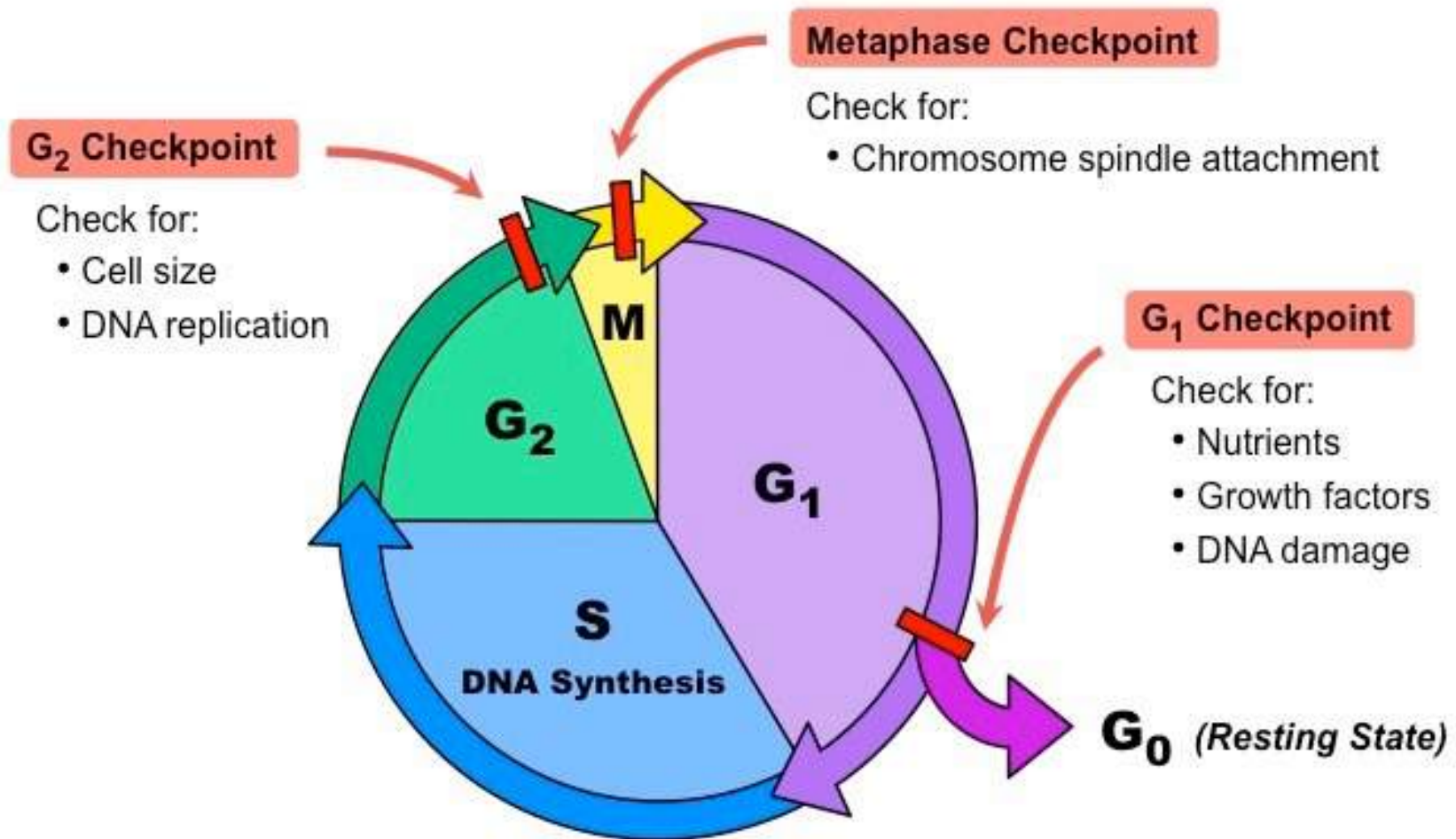
Cell Cycle

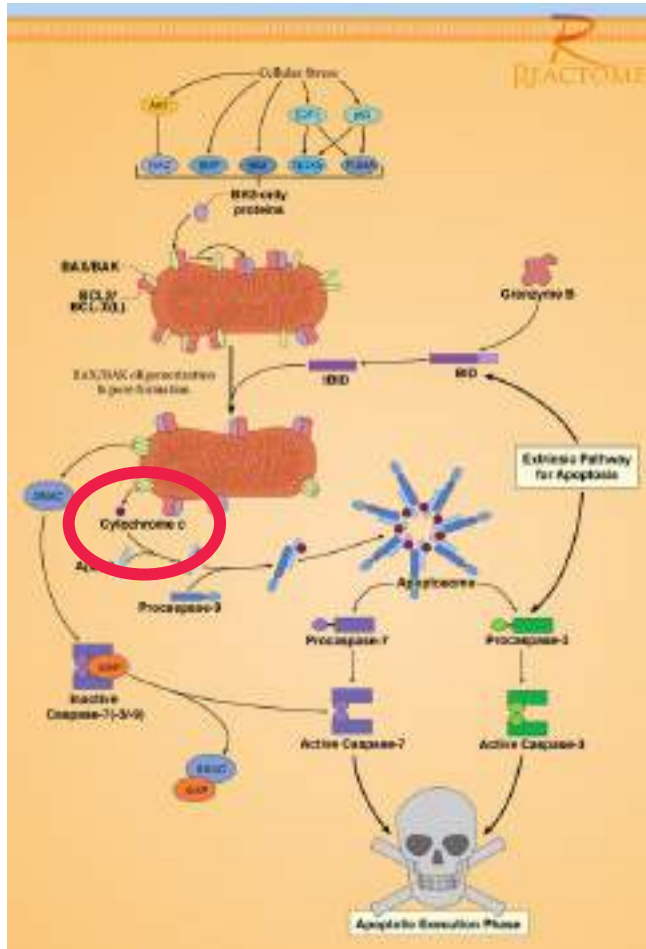
Binary Fission



Cell Cycle

Eukaryotic Cell Cycle



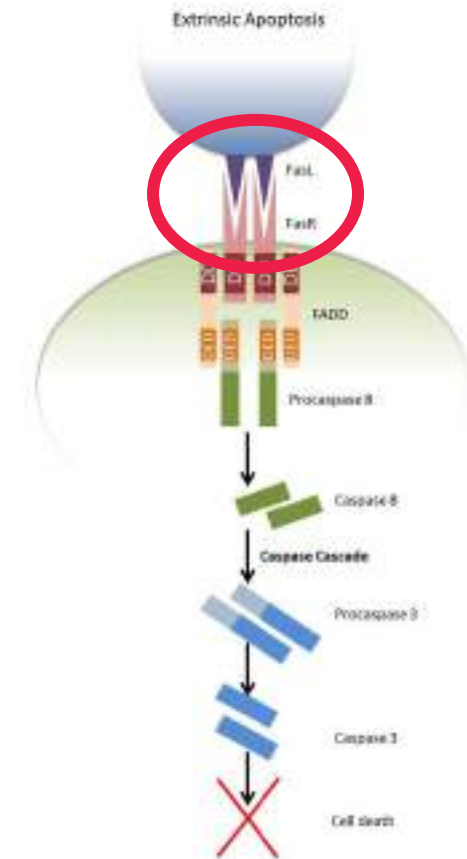


• Intrinsic

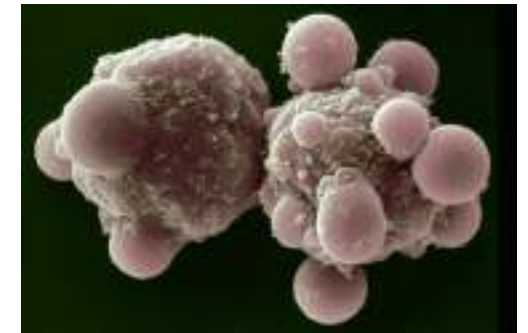
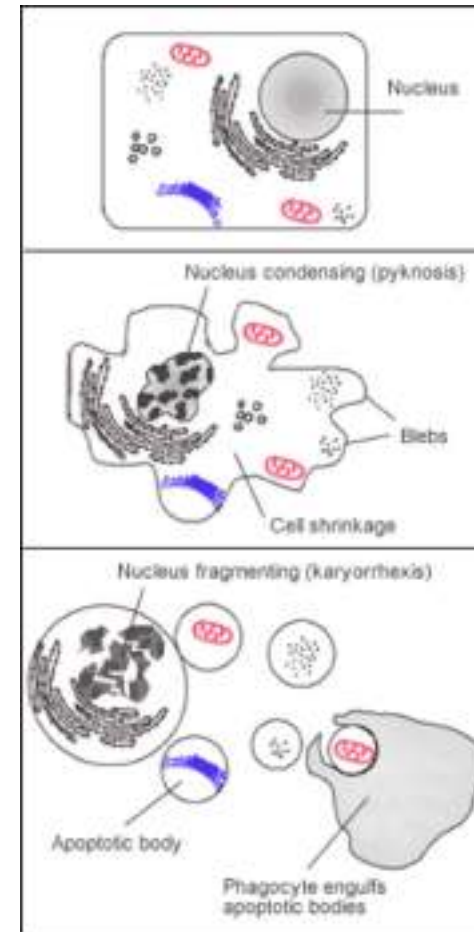
- *mitochondrial pathway*
- cell damage, including radiation, damaged DNA etc.

• Extrinsic

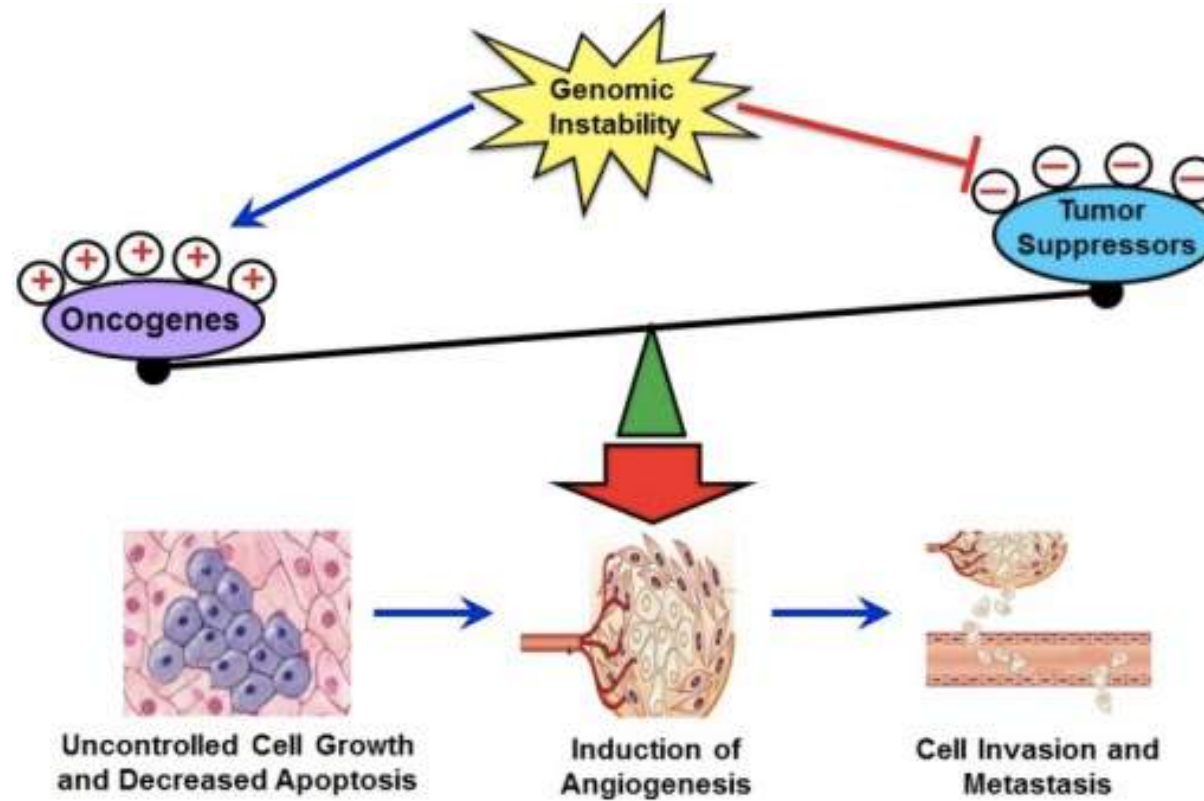
- death receptor pathway
- extracellular causes, such as changed conditions in extracellular fluid, infection etc.



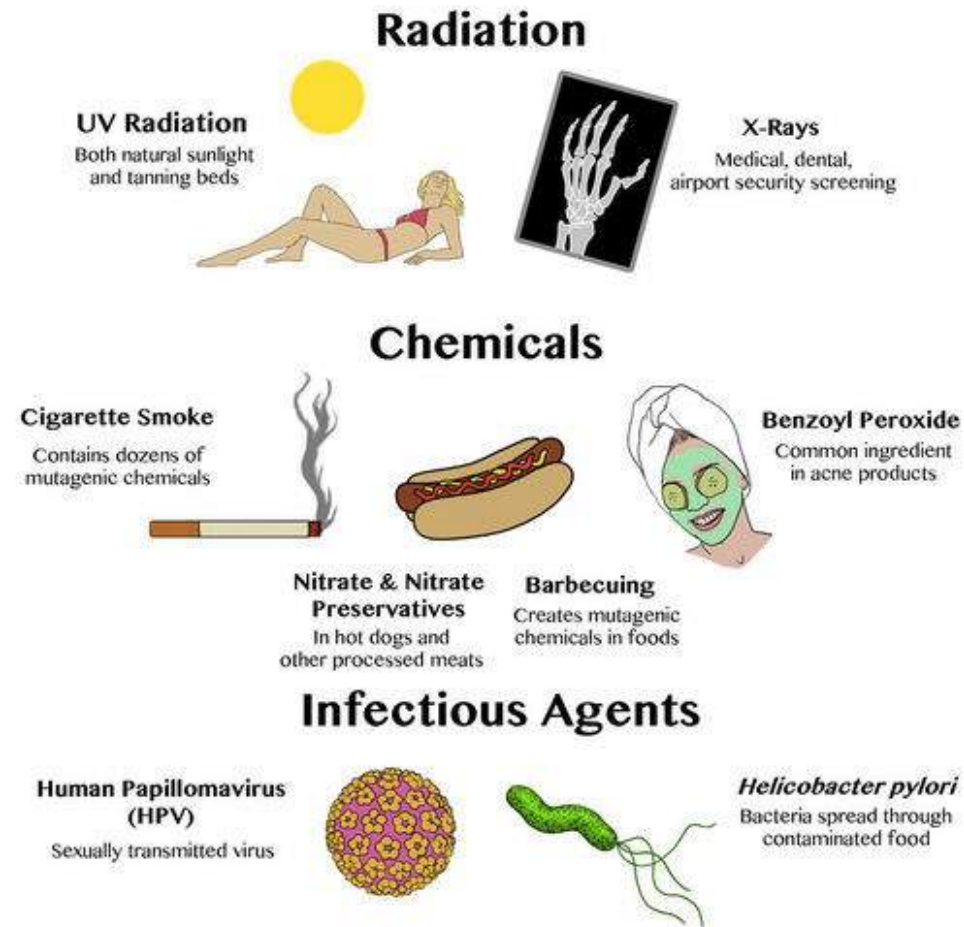
1. Activation of **caspases** is initiated
2. These caspases activate other caspases (*caspase cascade*)
3. These final caspases breakdown the cell's cytoskeleton as well as proteins in the nuclear membrane and Golgi apparatus
4. The cell shrinks and forms **blebs**
5. The cell breakdown into vesicles containing digested cell contents (**apoptotic bodies**)
6. Phagocytes are signalled to the site of apoptosis and they phagocytose the apoptotic bodies (prevents inflammation)



- Excess mitosis can lead to neoplasms
- **Benign** – localised masses
- **Potentially malignant** – localised masses that will eventually invade other tissues and transform into cancer
- **Malignant** (cancer) – masses that invade other tissues



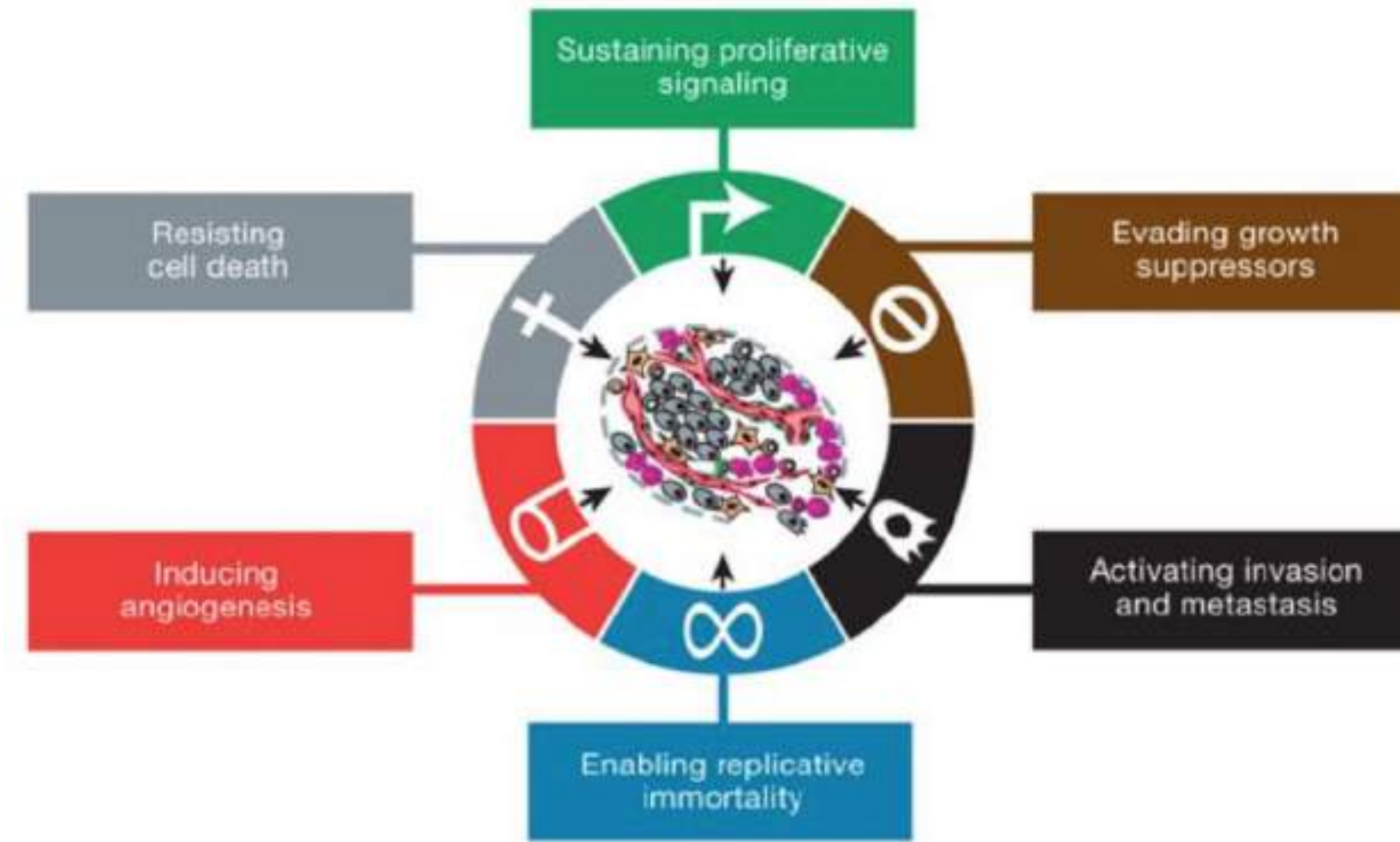
- What are mutagens?



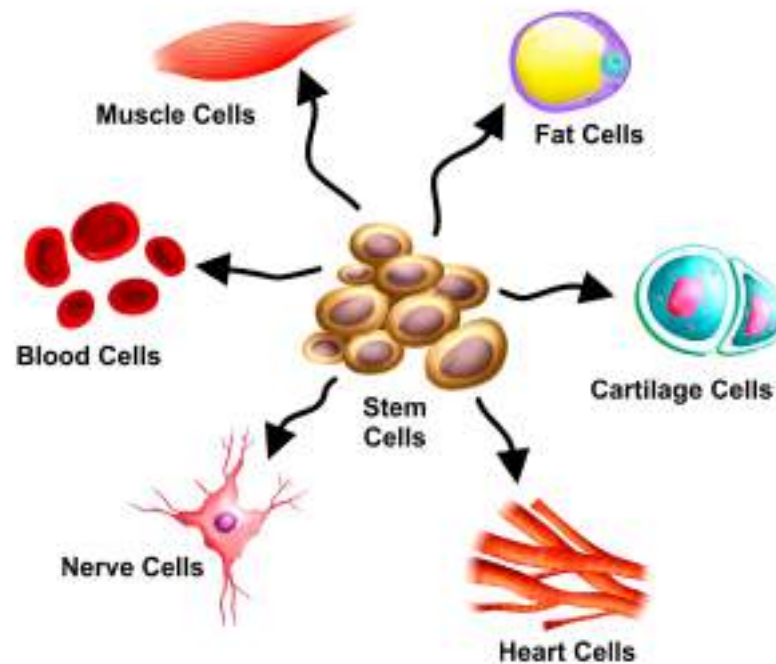
- **Mutagens** are factors which cause mutations in DNA (not to be confused with *mitogens*)
- **Carcinogens** (a mutagen which effects TSGs or proto-oncogenes) include:
 - **Chemical** factors: cigarette smoke
 - **Physical** factors: ionising radiation in X-rays
 - **Biological** factors: HPV and cervical cancer

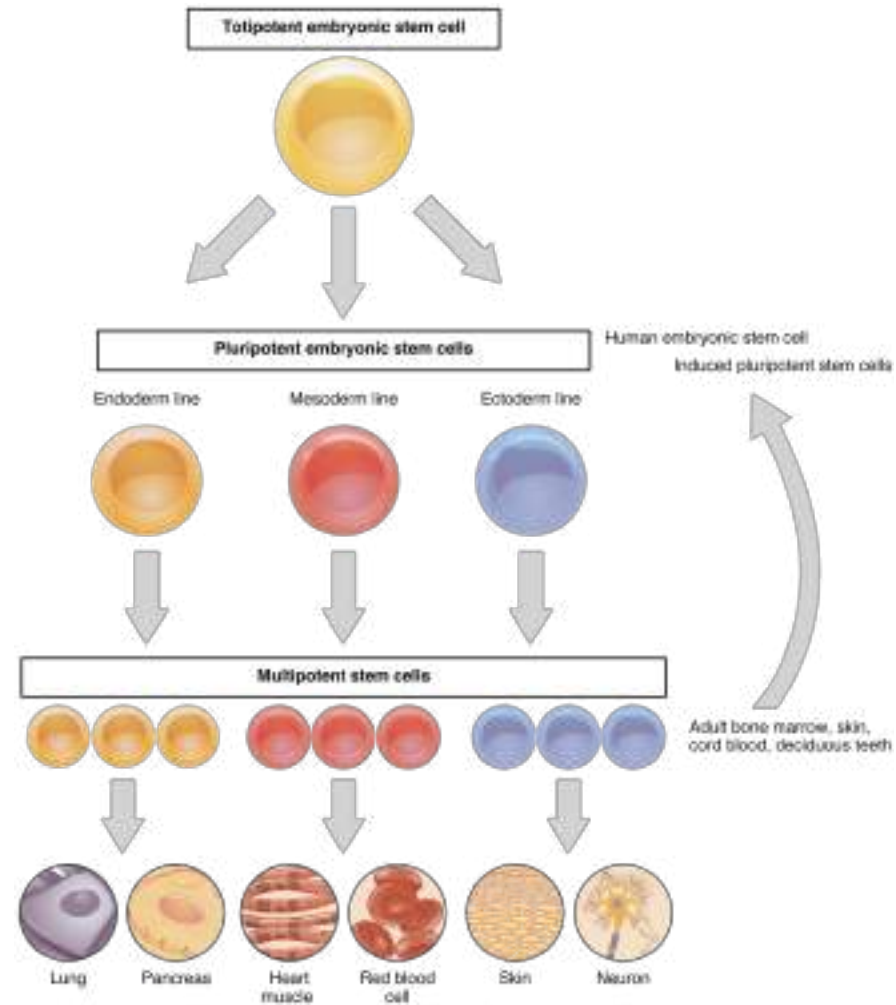


- **Loss of immunity:** immunocompromised individuals may be **unable to detect and destroy neoplasms**
- This can lead to the progression of malignant tumours, which would otherwise be eliminated in a healthy individual

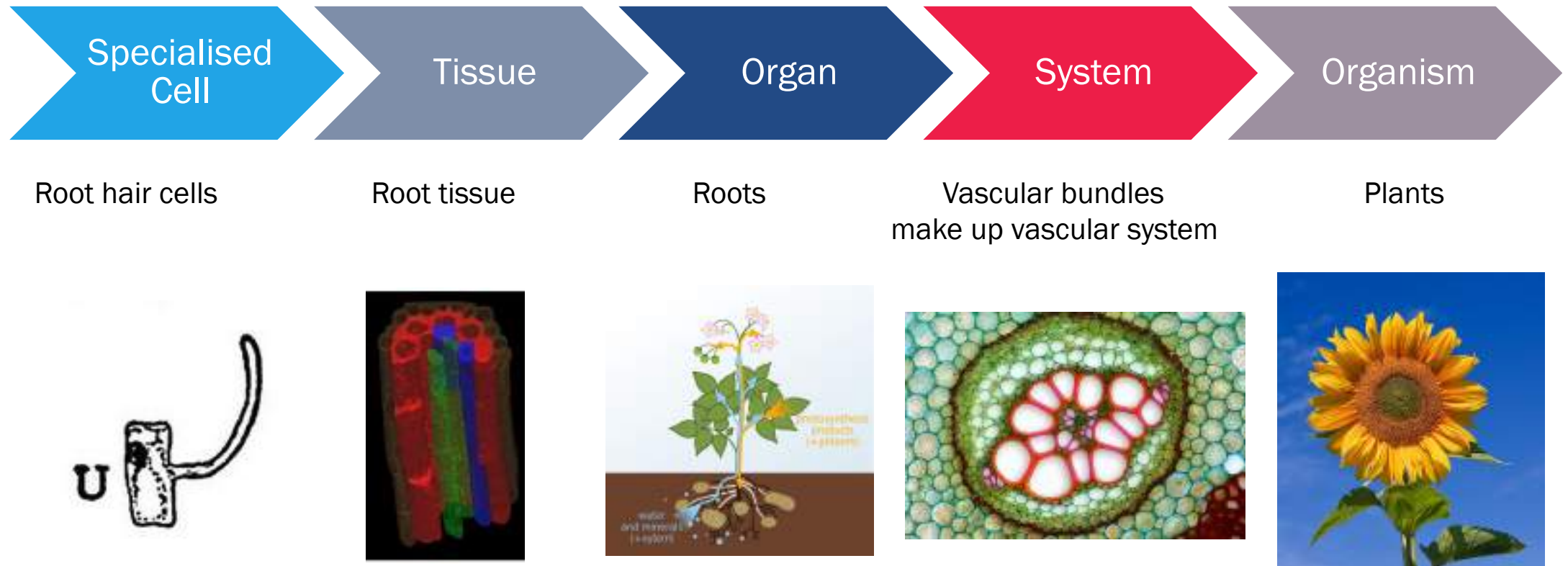


A cell that is **not yet differentiated** and has the potential to develop into different specialised cell types





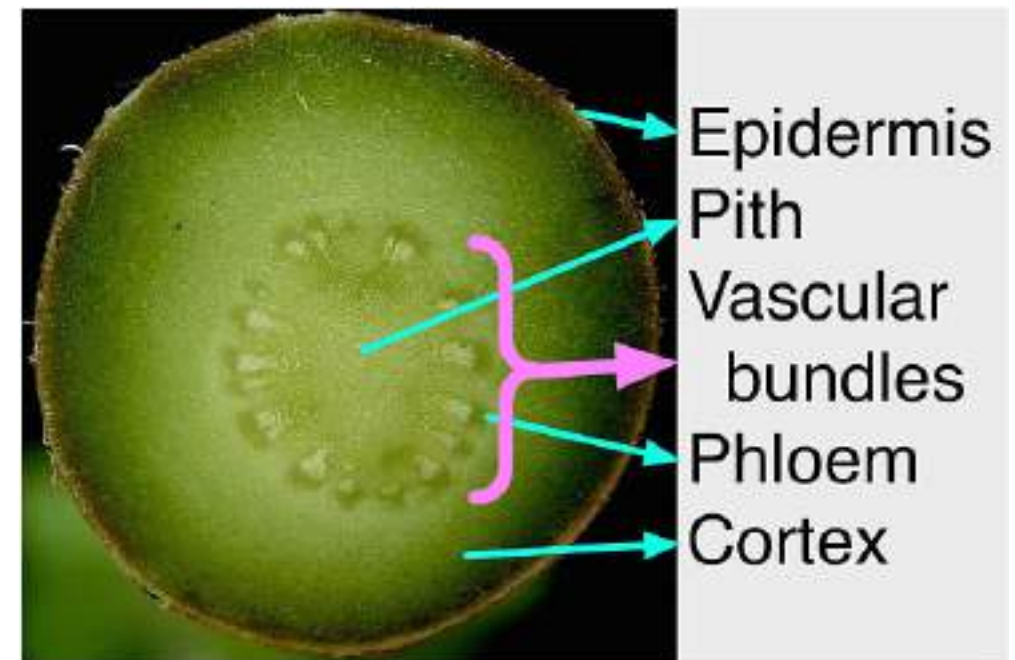
- *Embryonic stem cells* are totipotent or pluripotent. They can be obtained from IVF programs and can replicate indefinitely.
- *Adult stem cells* are multipotent or unipotent. They function to repair and regenerate damaged and aged tissues. Cannot replicate indefinitely.



Plant Systems

What are Vascular Plants?

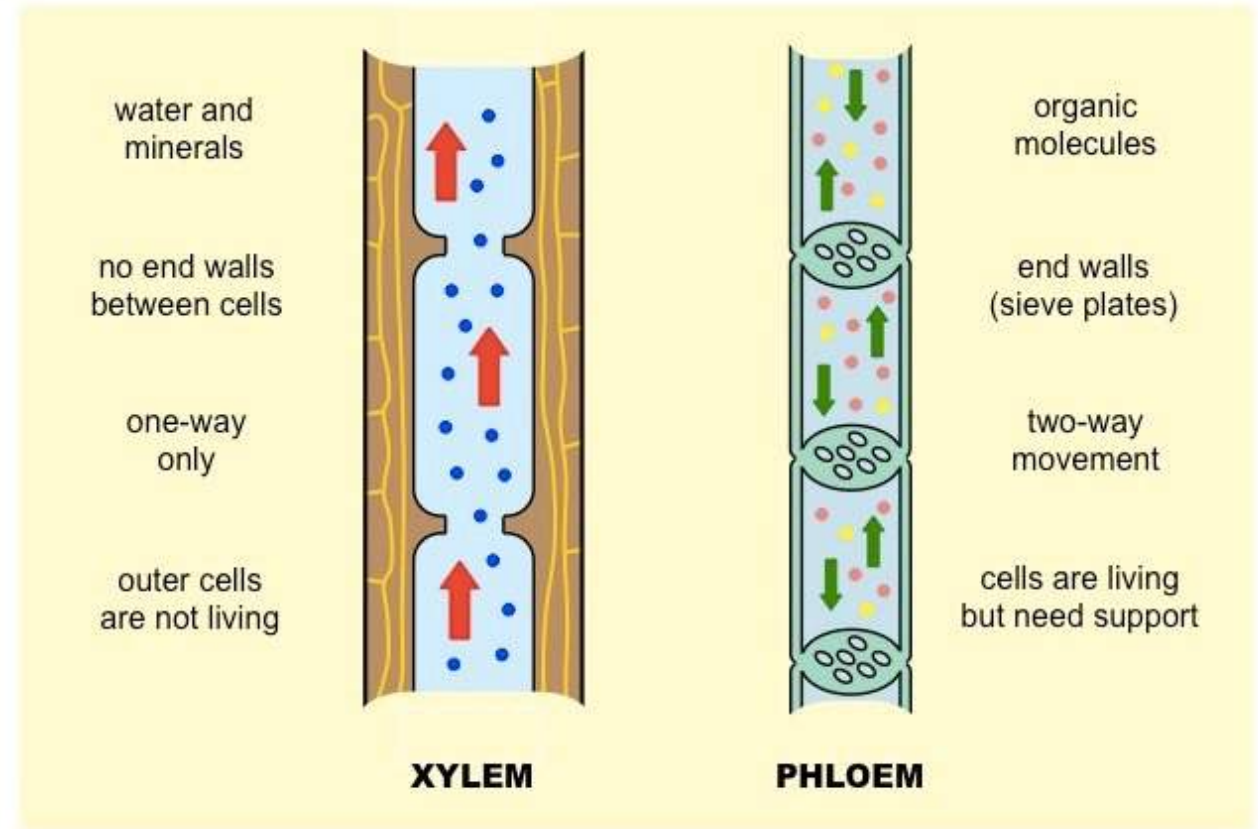
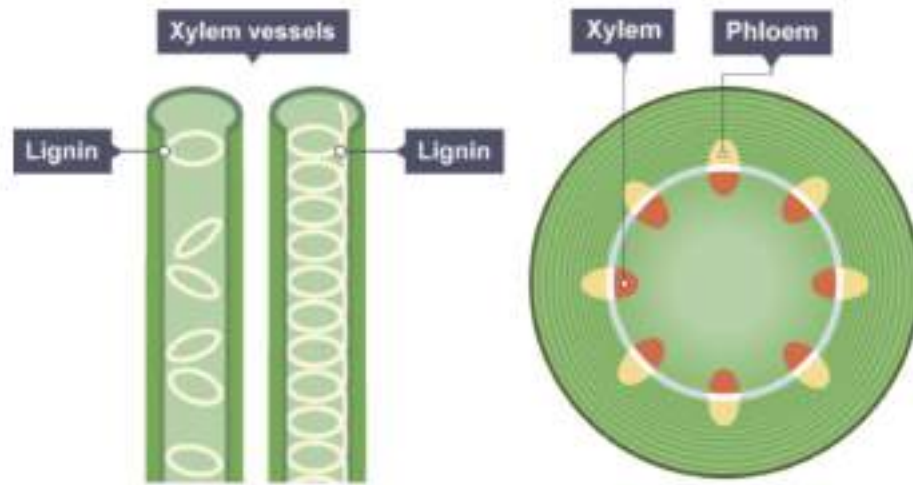
- Vascular plants are those which have specialized tissues for conducting *water, minerals and photosynthetic products* through the plant
- (nonvascular plants have simplified tissues and absorb water directly through osmosis through their cell walls)



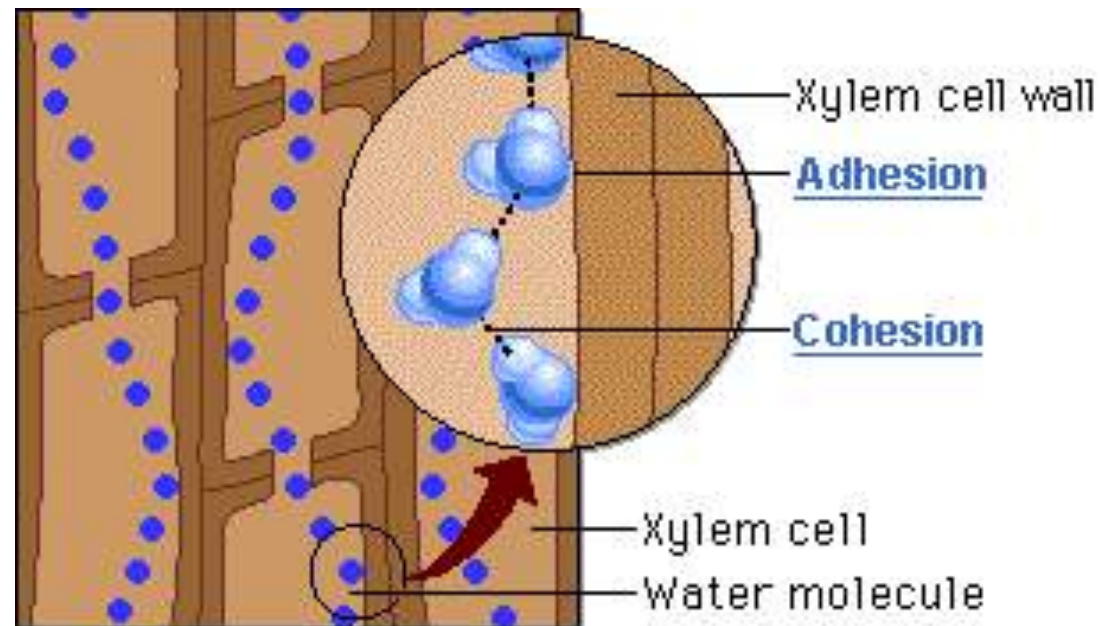
- In vascular plants, transport occurs due to vascular bundles that move water, mineral ions and sugars around the plant
- These vascular bundles consist of:
 - **Xylem:** transports water and nutrients from roots to leaves
 - **Phloem:** transports sugars produced from photosynthesis from leaves to roots
 - **Lignin:** provides strength and structure to plant

Plant Systems

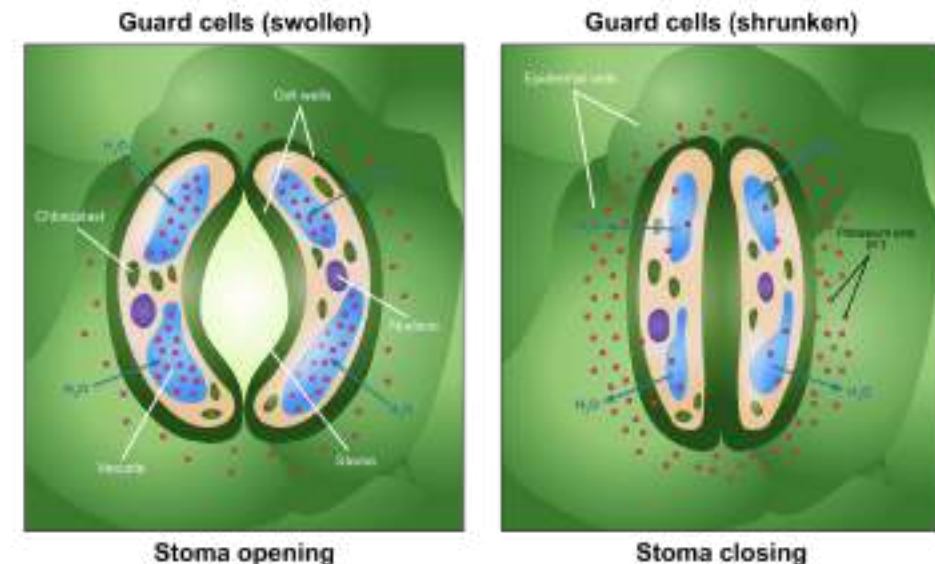
Xylem, Phloem + Lignin



- Water is absorbed through the root hair cells
- The water is pulled up through the roots into the stem using...
COHESION
- It pulls the water up like a vacuum

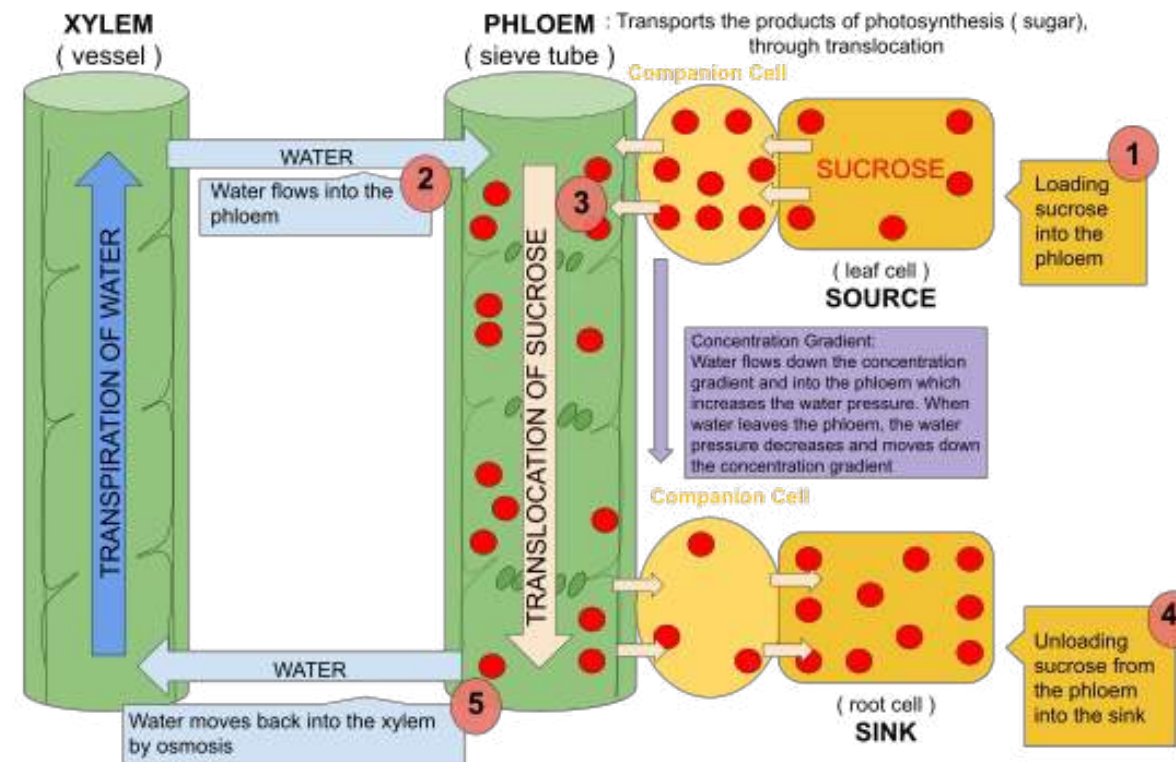


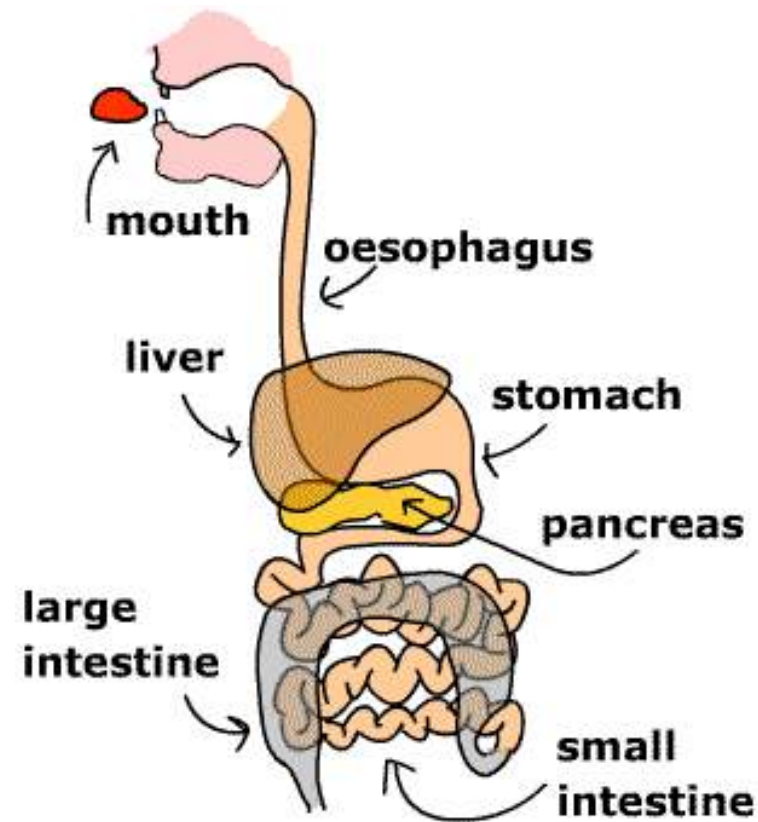
- When it reaches the leaves of the plant, water can exit through the stomata
- If the guard cells are full of water, they will open, letting water out
- If the guard cells are flaccid (not much water), they will close so no more water can leave the plant



- **HUMIDITY**
 - transpiration decreases when there is a lot of water vapour in the air
 - this reduces the water concentration between the leaves and air, so less water molecules evaporate
- **TEMPERATURE**
 - transpiration increases as temperature increases
 - this is because heat energy increases the rate of water evaporation
- **WIND**
 - as wind (air currents) increase, the rate of transpiration increases due to increasing the rate of water evaporation
- **TIME OF DAY**
 - the rate of transpiration decreases at night due to it being cooler and more humid

- Movement of sucrose from the leaves to the rest of the plant





- The purpose of the digestive system is to **obtain nutrients from food** by breaking it down
- **Digestion** is the breakdown of food into a form that can be used by an organism for metabolism (chemical processes)
- Digestion can occur due to ***physical*** and ***chemical*** mechanisms
- As mammals are heterotrophs, they require eating other organisms to obtain their nutrients. These nutrients are obtained from the breakdown of organisms

Specialised Cell: Villi

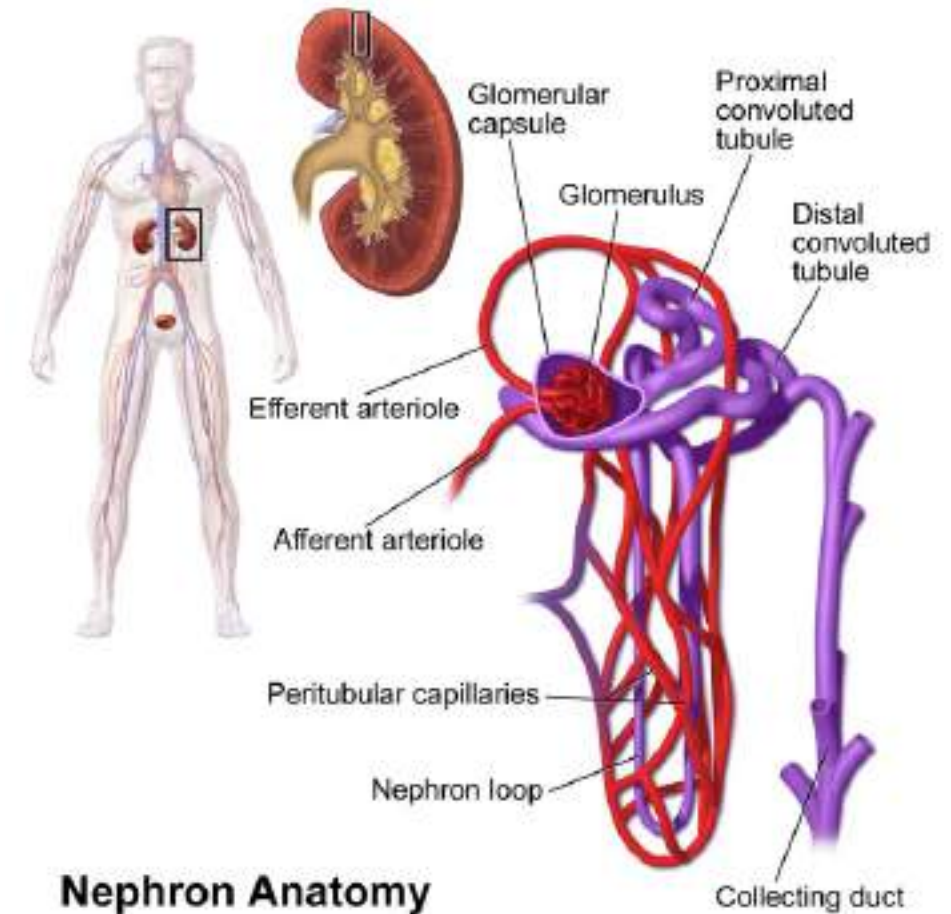
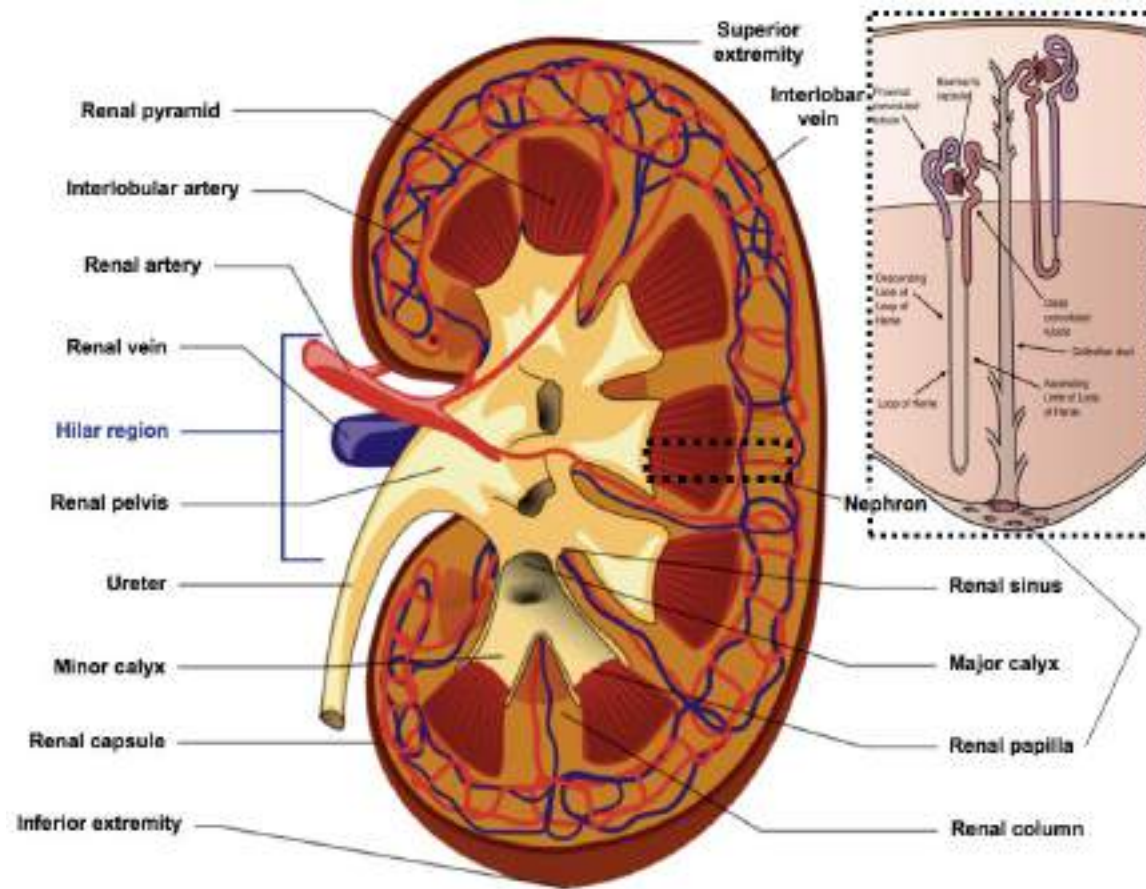


Tissue: Small intestine tissue

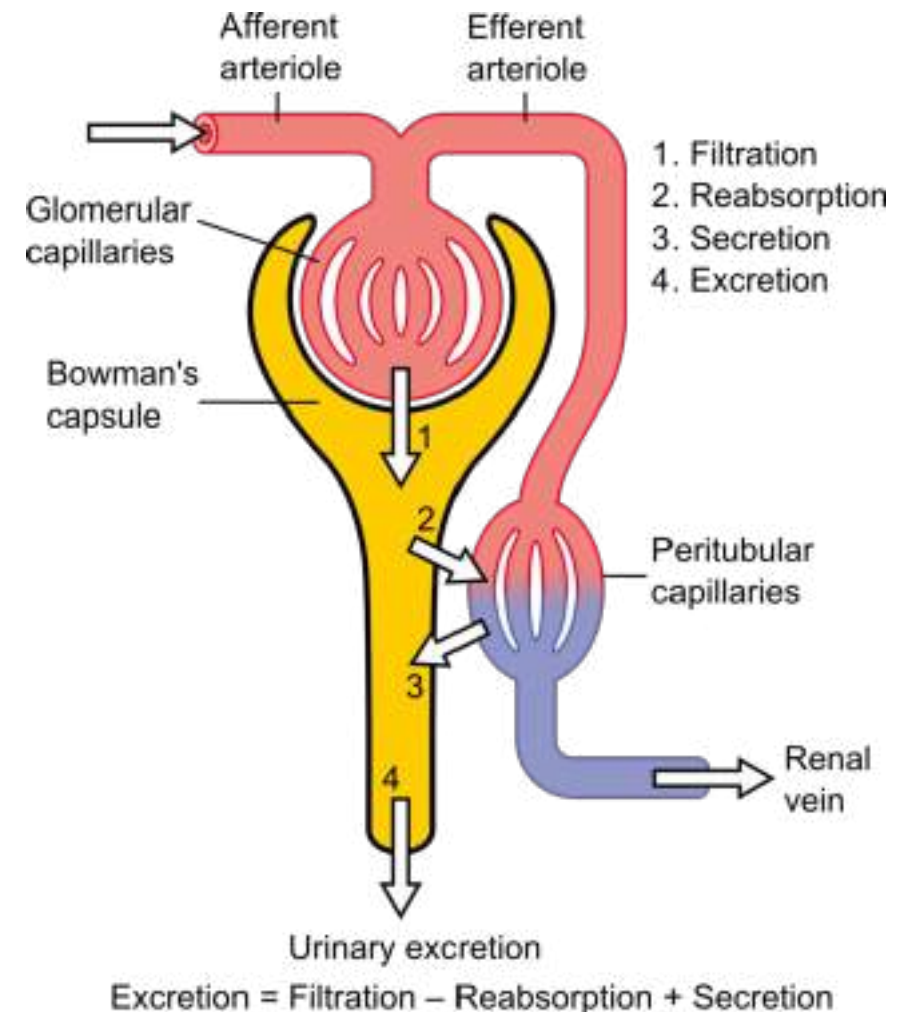
Organ: Small intestine

System: Digestive system

Organism: Humans!



- Each kidney is made up of subsections called *nephrons*
- Blood enters the kidney from the aorta (part of the circulatory system)
- It enters the *Bowman's capsule*, which filters out blood cells and proteins (only water and small molecules pass through)
- The solution (with water and small molecules) passes through tubing, where salts, glucose, amino acids and water is absorbed
- Everything that is not reabsorbed is excreted in urine



Specialised Cell: Nephrons



Tissue: Kidney tissue

Organ: Kidney

System: Excretory system

Organism: Humans!

- Glands are **organs** located around the body. Endocrine glands produce and store **hormones** for release into the **bloodstream**
- They regulate how much of each hormone is released, depending on the levels of hormones (or other substances) already present in the blood
- Things such as stress, infection and changes in fluid balance can affect hormone levels

Specialised Cell: Secretory epithelial cells



Tissue: Glandular tissue

Organ: Glands

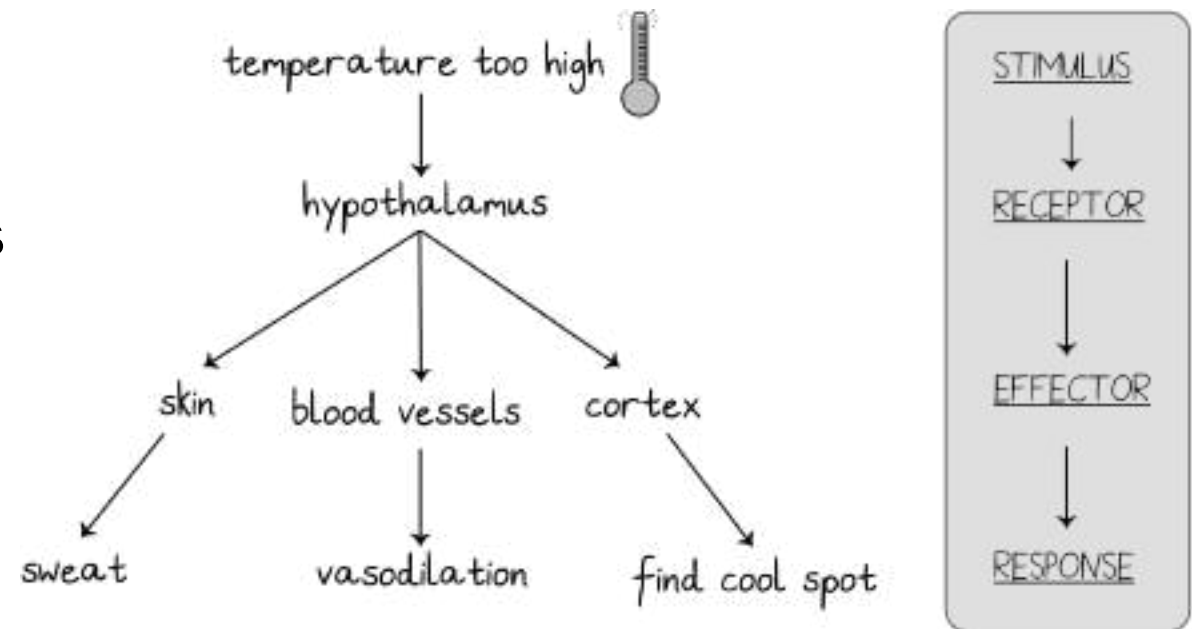
System: Endocrine system

Organism: Humans!

Homeostasis

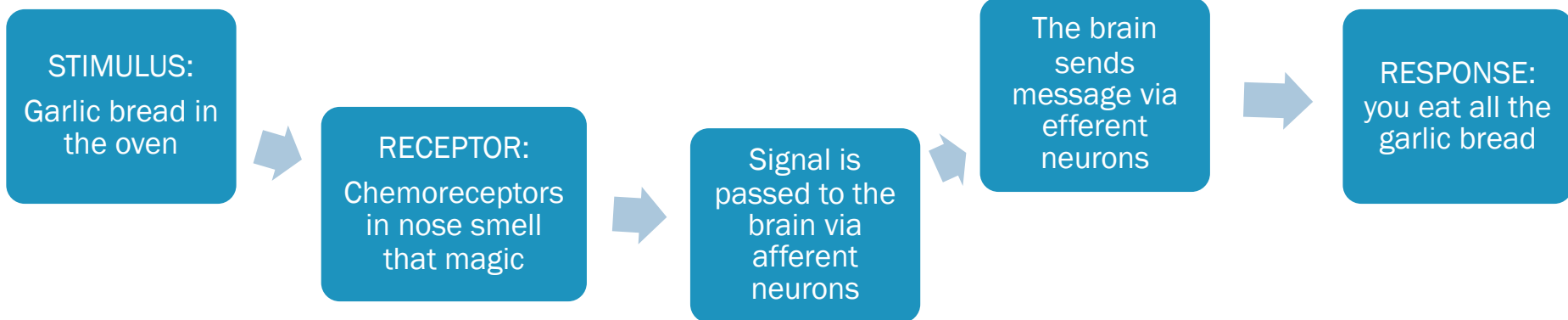
Stimulus-response Model

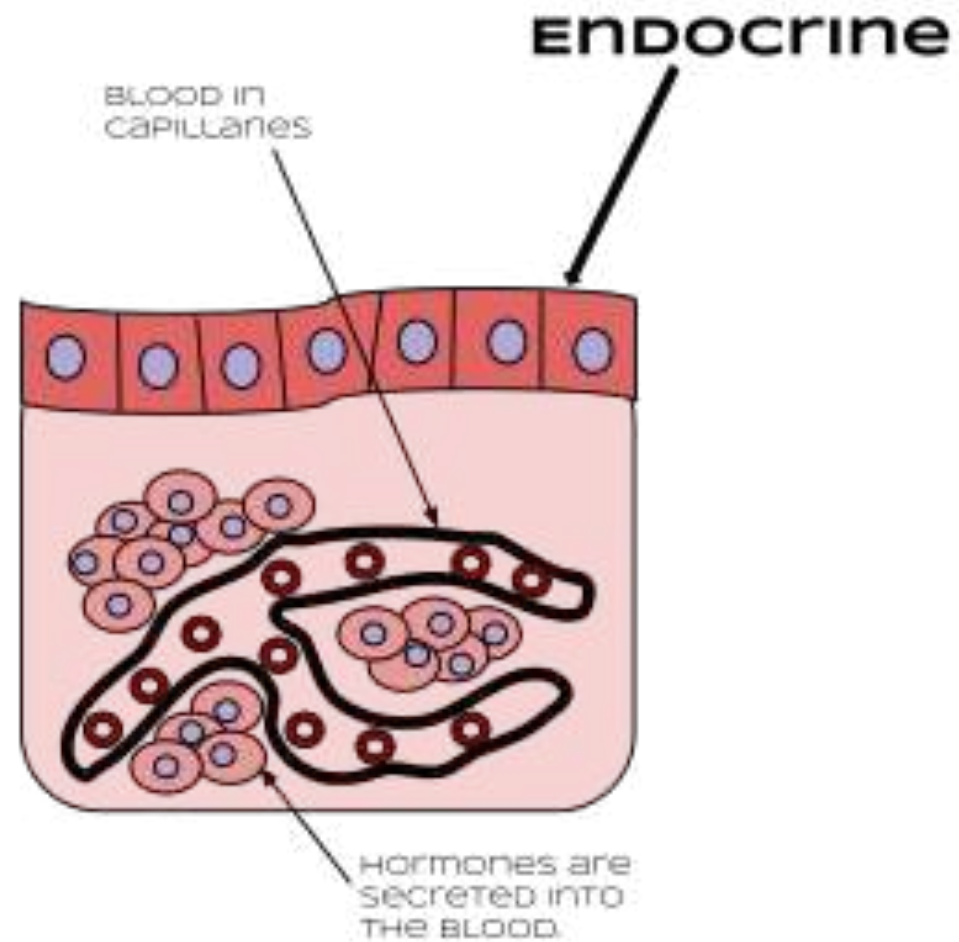
- **Stimulus:** a change in the environment (either external or internal)
- **Receptor:** transform environmental stimuli into electrical nerve impulses
- Impulses are then transmitted via neurons to the **central nervous system**
- Signal is transmitted via neurons to effectors
- **Effectors:** organs that produce a response to a stimulus



Homeostasis

Stimulus-response Model





Thermoregulation

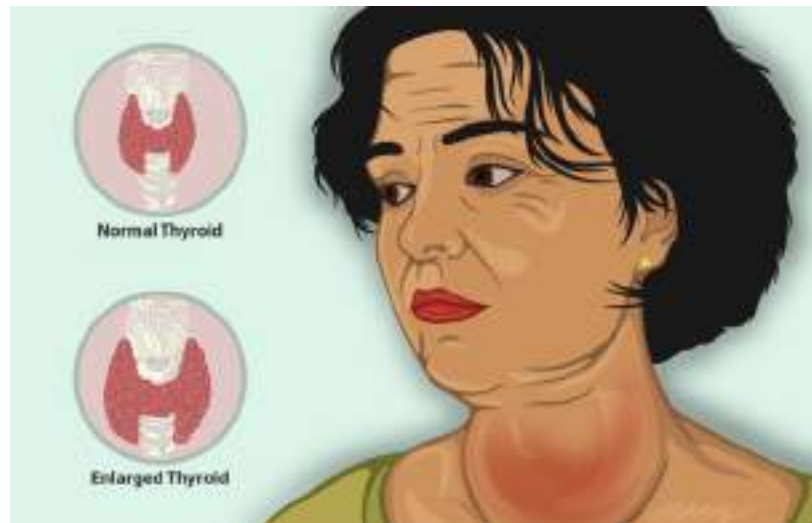
Water regulation
(osmoregulation)

Blood glucose
regulation

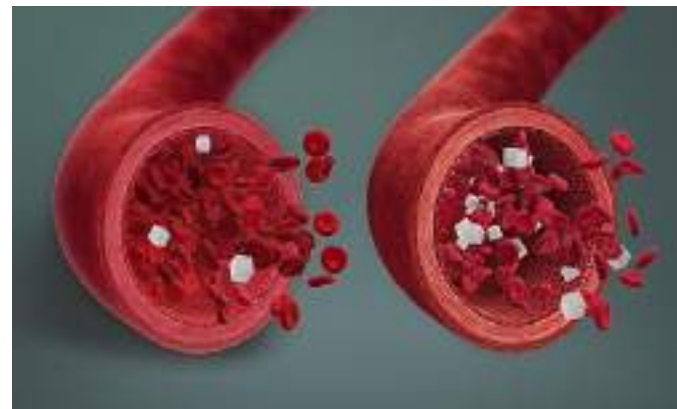
Homeostasis

Homeostatic Malfunctions

overproduction of thyroxine



lack of insulin





Woosh. You will pass
your exams.